240

MACHINERY

OCTOBER 15, 1958
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One reason for the dependable operation of the Massey-Ferguson No. 701 Baler is its extremely accurate foolproof knotting mechanism. NINE Harper Castings go into the working parts, which are all precision-made to ensure long and trouble-free operation.

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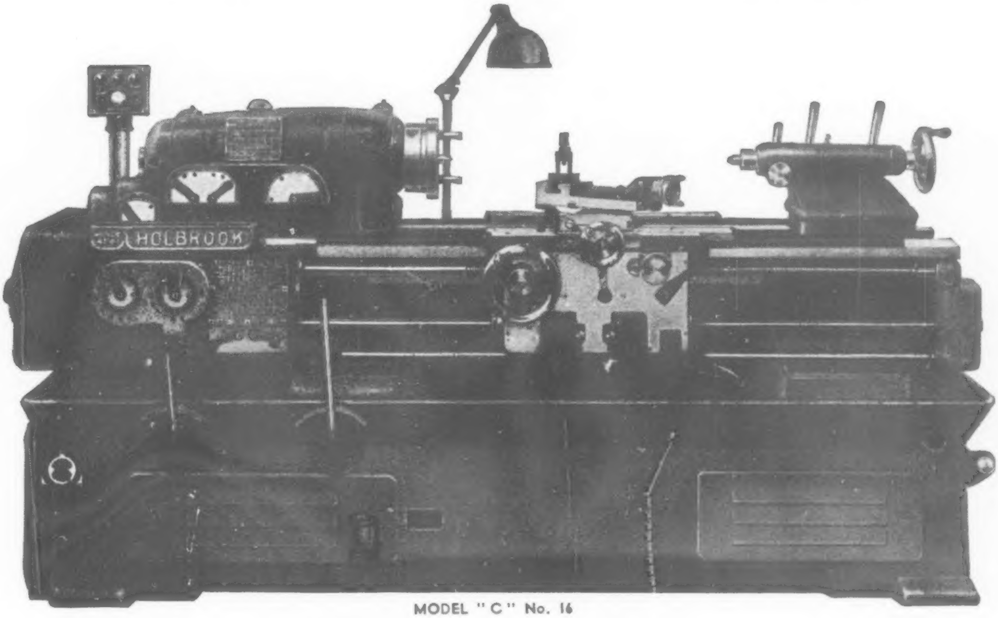

MODEL "C" No. 16

MODEL "C"

PRECISION LATHES

BUILT IN 3 SIZES

SWINGING 10 - 13 - 16 INCHES OVER BEDWAYS

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SIX GEARED SPEEDS, CHANGED WHILST RUNNING.
SUPER FINISHED SPINDLE RUNS IN WHITE-METAL BEARINGS.
SPINDLE AUTOMATICALLY LUBRICATED WITH FILTERED OIL.
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BUILT-IN TAPER TURNING EQUIPMENT. ELECTRIC SUDS PUMP.
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don't be prehistoric...

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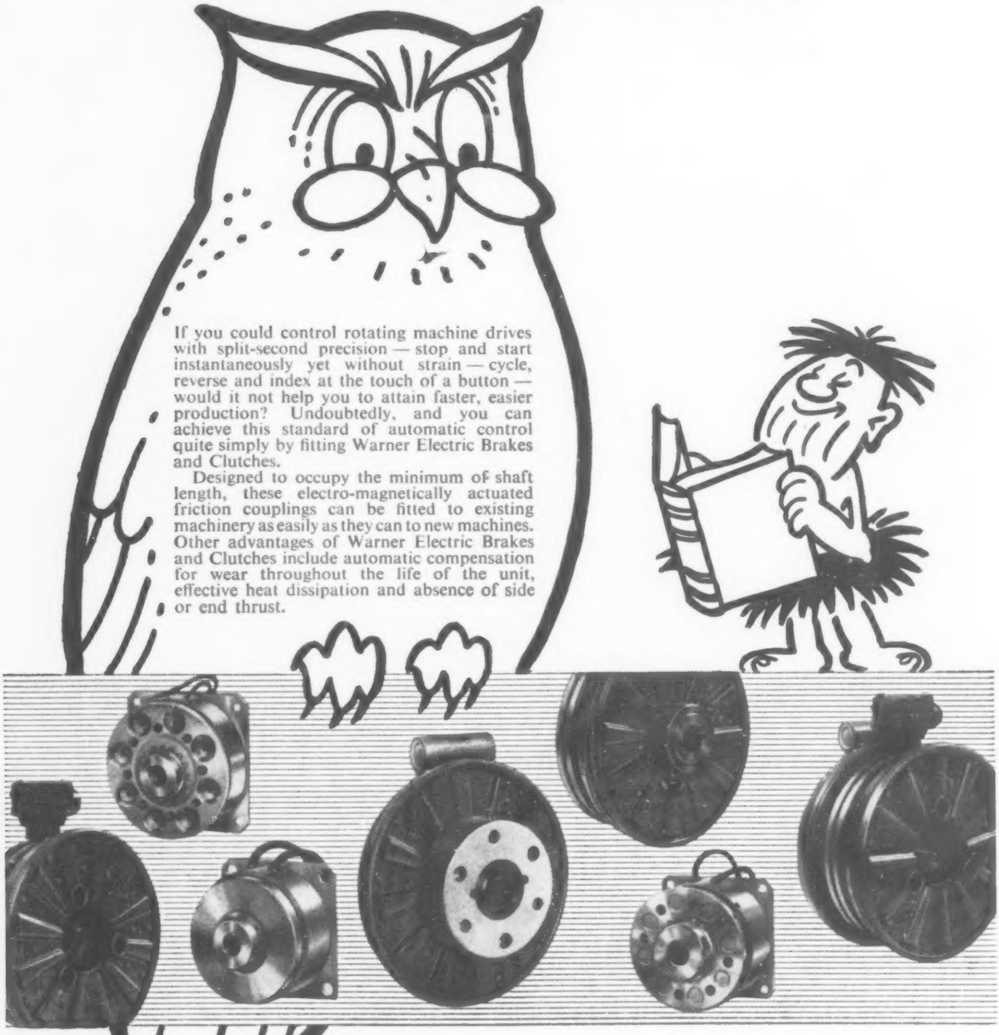

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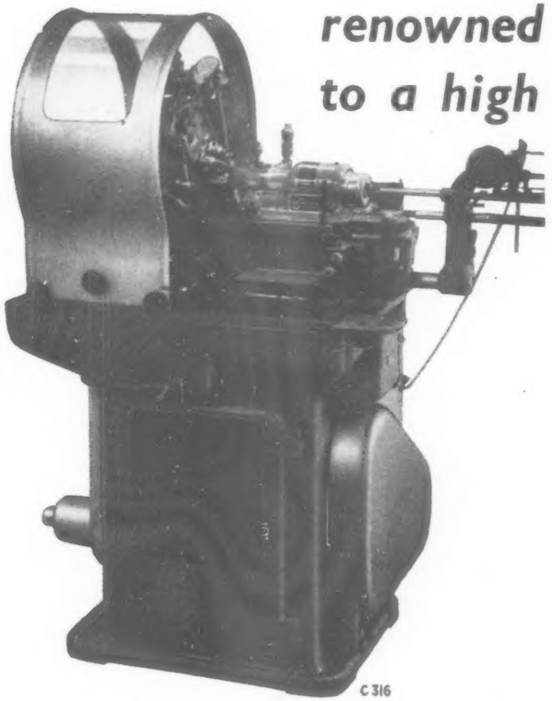
renowned for producing work to a high degree of accuracy



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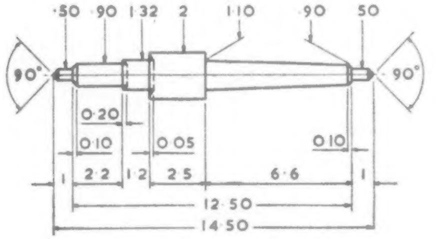

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This steel pinion is produced in 36 seconds.
Spindle Speed 3345 r.p.m. Cutting speed 74 ft. per min.

Range of machines also available with similar capacities as above and fitted with a 6-spindle revolving turret which reduces idle time to the minimum. Eleven tool positions available. Multi-diameter drills and reamers unnecessary. Up to four spindles can be used for screwing or tapping at one setting.

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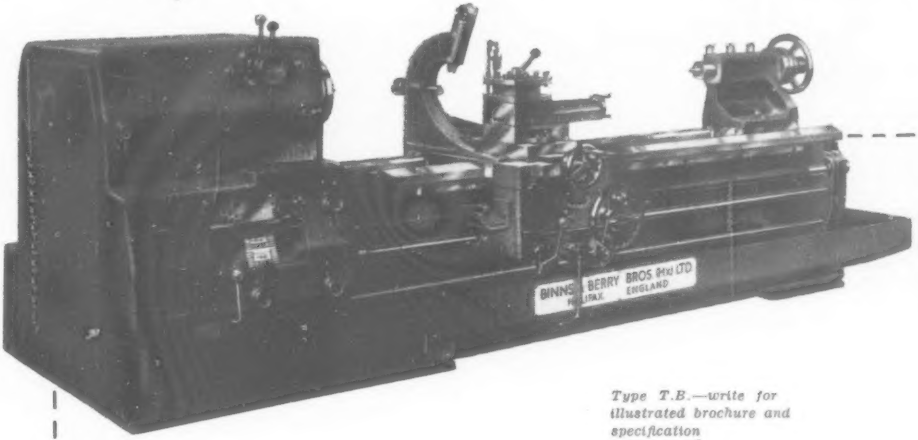

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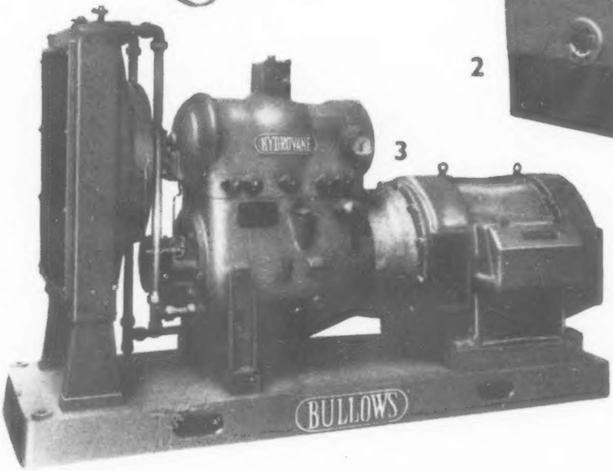
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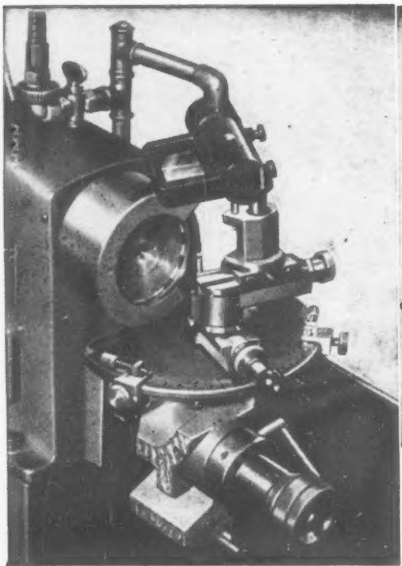

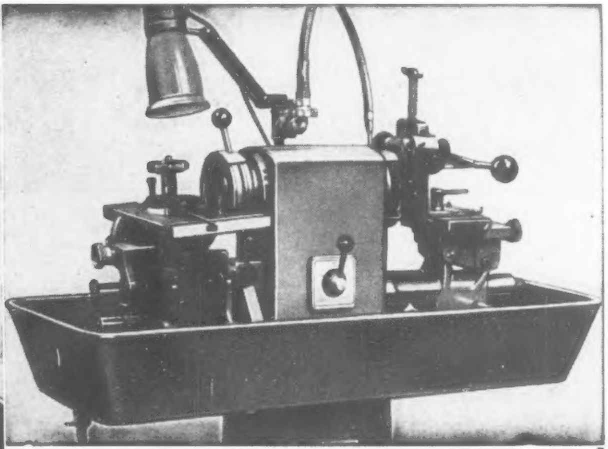

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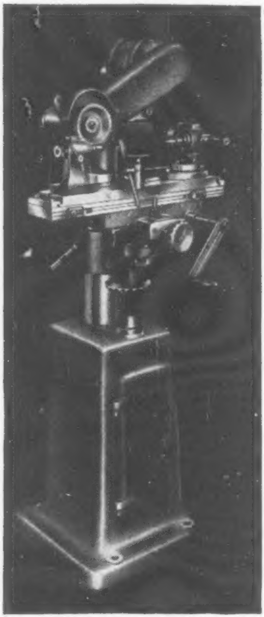

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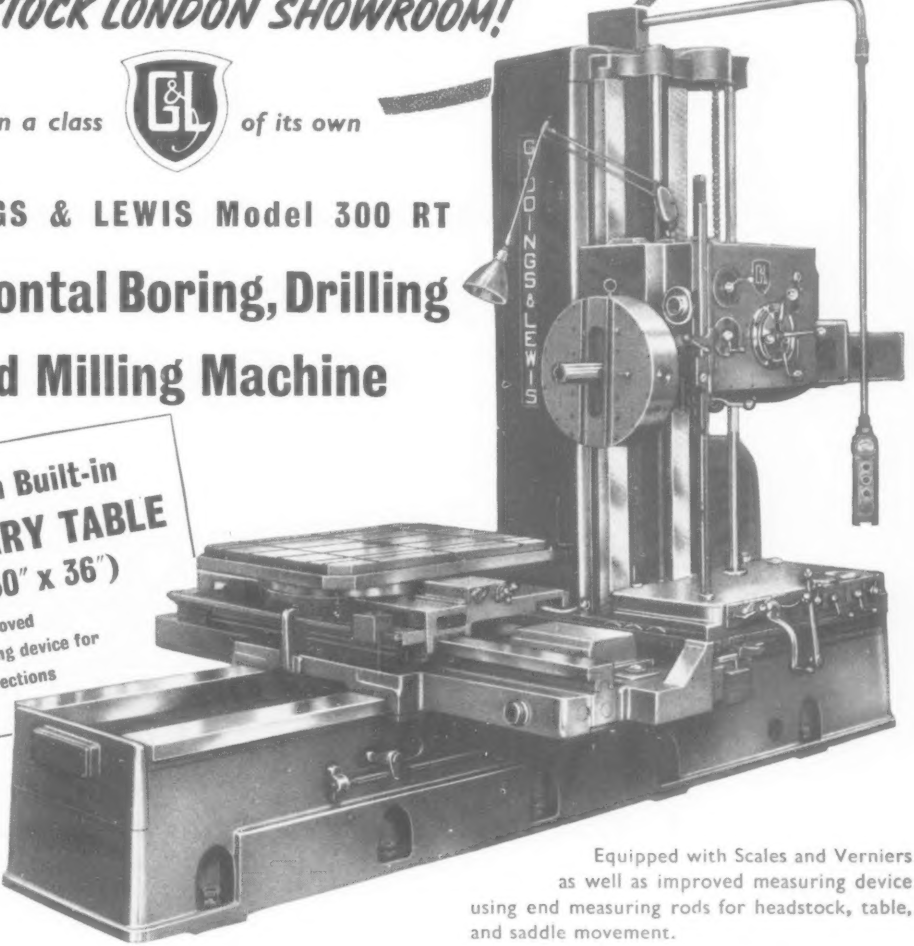

with Built-in ROTARY TABLE (30″ x 36″)

and improved measuring device for all 3 directions

★
Note length at bed and vertical travel of headstock

Equipped with Scales and Verniers as well as improved measuring device using end measuring rods for headstock, table, and saddle movement.

This machine has all the well-known Giddings and Lewis features including—Hardened Bed and Saddle ways, 22″ facing head with telescopic tools, and above all, heavy stock removal coupled with an exceptional degree of lasting accuracy.

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Dia. of Spindle	3″
Length of Bed	72″
Vertical travel of headstock	45″
Built-in Rotary Table—30″ x 36″ with 36″ cross feed	

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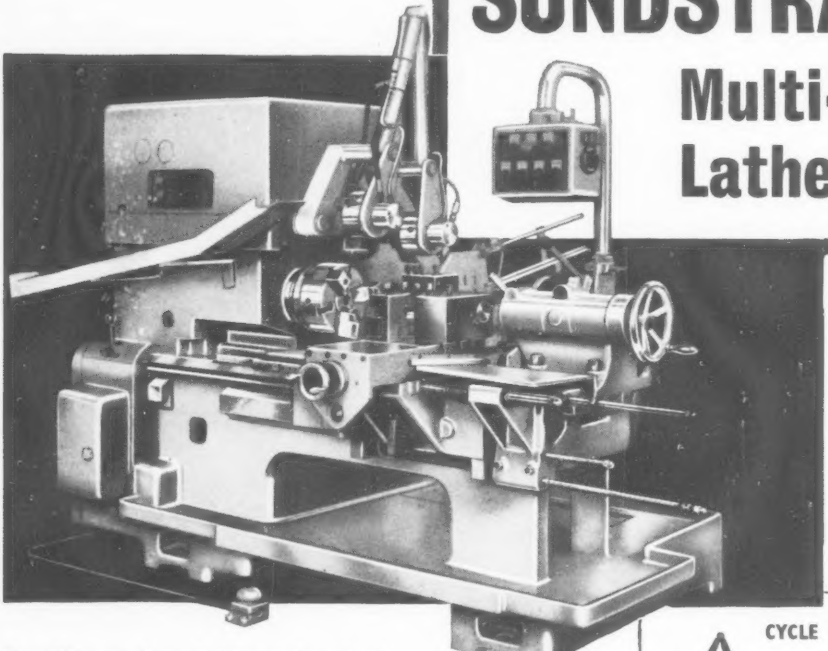
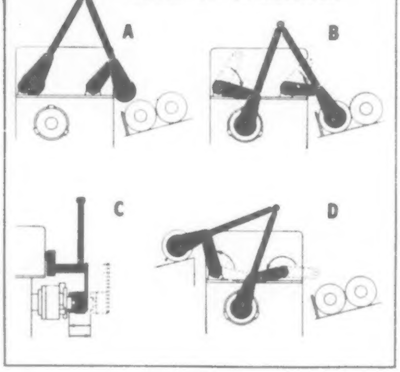


Easily and quickly adapted to handle various sizes and shapes of workpieces.

The machine illustrated is fitted with an automatic loading and unloading attachment operated hydraulically from a simple control disc fitted with adjustable stops. The two arms are each fitted with hydraulically operated chucks which allow the arm on the right-hand side to pick up components from a magazine, and load them into the chuck, while the left-hand arm removes and unloads completed workpieces from the machine.

CYCLE OF OPERATIONS



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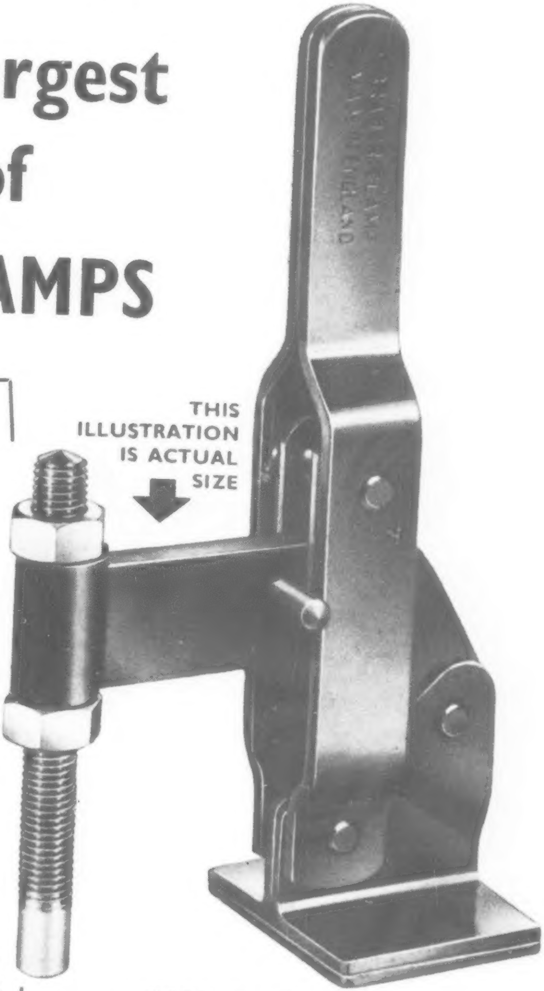

THIS ILLUSTRATION IS ACTUAL SIZE

MODEL TC.80

ONE OF THE BRAUER SERIES OF TOGGLE CLAMPS

F. BRAUER LIMITED DESIGNING & MANUFACTURING ENGINEERS

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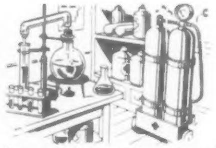
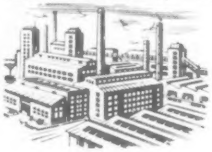


On Hospital equipment using medical gases, or on industrial plant where compressed air, coal gas or calor gas is used SPOT-LEAK is invaluable for installation and checking tests as well as for the detection of suspected leaks on established systems.



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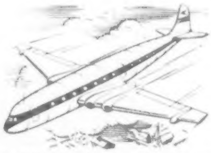

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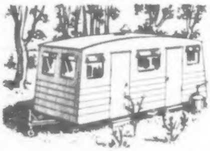
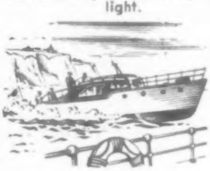
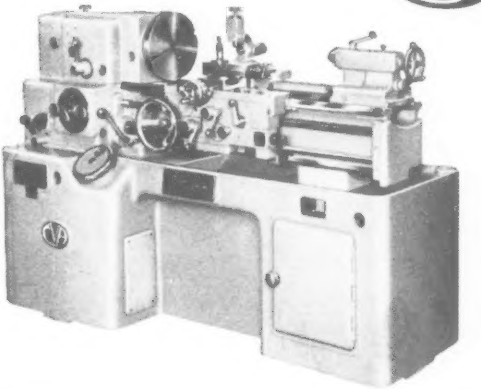


SPOT-LEAK finds the leaks in pipes, valves, joints and radiators of central heating or coal gas plant in the home. It is invaluable for testing calor gas lighting or heating systems in Caravans or Boats where space is limited and headroom small with the necessity to work by flashlight.





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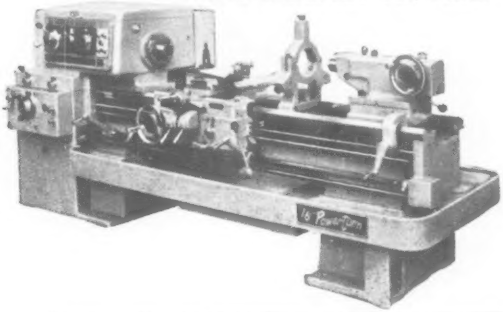

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Model 13" swings 18" over bed.
Model 16" swings 20½" over bed.
Model 20" swings 24¾" over bed.

All models available with 54", 78", or 126" between centres.

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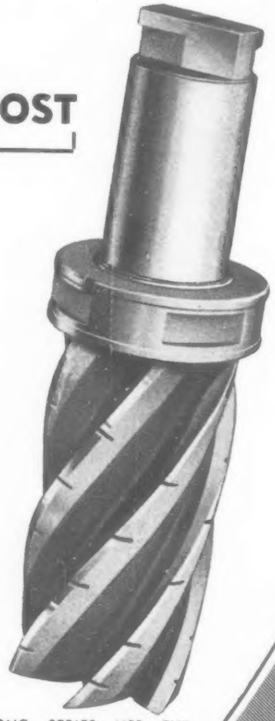

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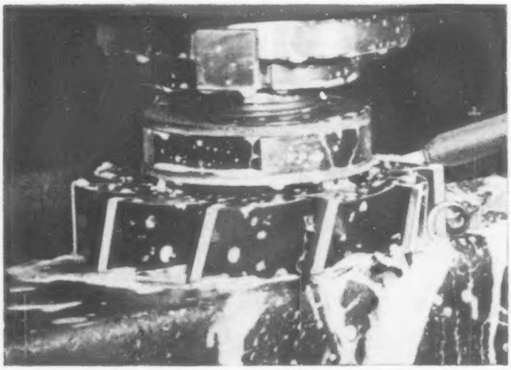

6" dia. stellite tipped facemill machining .60/.65 carbon steel. 4" wide x ¾" deep at 5⅞" feed removing 8.80 cu. ins. per min.

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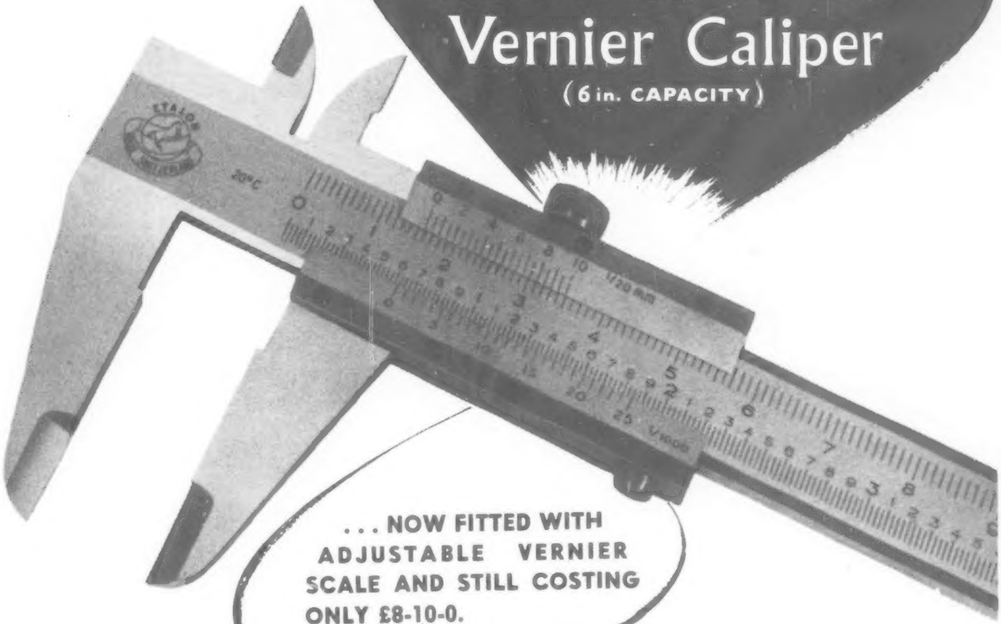
No. 7 of a series illustrating the Clare Milling system.



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No. 17 Universal
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ROCH-ETALON tools offer you the utmost in precision and accuracy. Each ETALON instrument goes through a rigid inspection before leaving the factory.

ROCH-ETALON instruments are manufactured by the world famous SWISS precision instrument maker Pierre Roch; a further guarantee that when you BUY ETALON — you BUY THE FINEST. All ETALON tools are furnished in handsome form fitting cases.

SPECIAL FEATURES

Combination inside, outside, and root measurements.
Convenient depth gauge included.
All readings on same vernier.
Manufactured entirely of hardened stainless steel.
Specially seasoned to relieve all hardening strains and so prevent any alteration in size or shape.
Carefully lapped measuring surfaces to guarantee absolute accuracy.
Hand fitted vernier slide insures smooth, snug operation.
Convenient thumb screw lock eliminates inaccuracy when setting.
Readings in 1000ths of an inch on bottom scale, 1/20mm. on top scale.
World famous SWISS craftsmanship guarantees highest precision and accuracy.
Satin chrome finish with recessed scale which eliminates any possibility of wear on graduations.

Vernier Calipers from 4" capacity to 72" capacity always available ex stock.

Delivery Ex-Stock London or from any first class merchant. Sole Importers into the United Kingdom—

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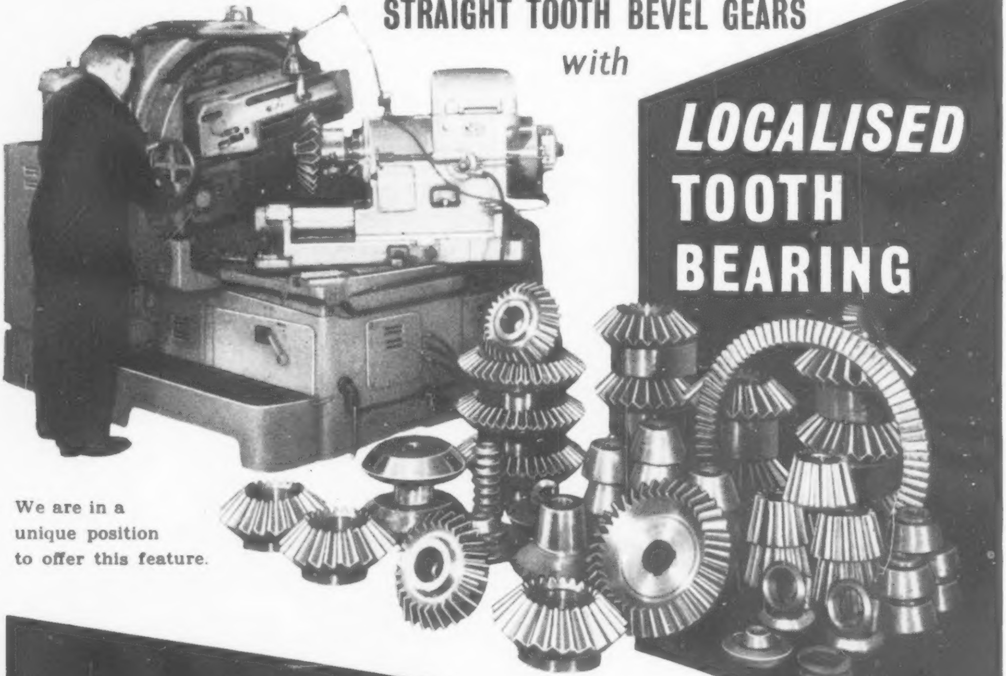

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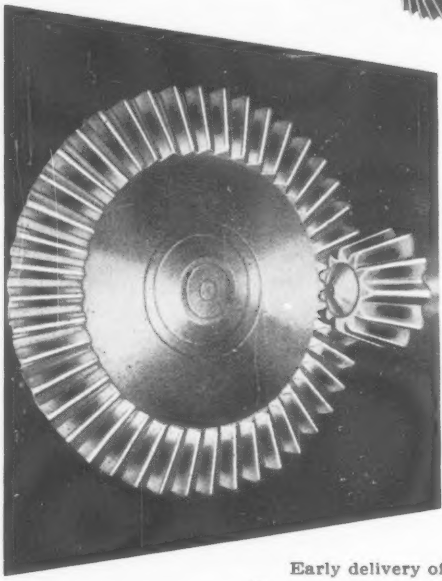

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Capacity: mitres 25″ diameter
bevels up to 35½″ diameter
maximum pitch 1½ D.P.

Your enquiries are invited for bevel gears with localised tooth bearing and also for spurs up to 8′ 6″ diameter, bevels up to 6′ diameter, worms and worm wheels, etc.

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on Capstan
and Turret Lathes

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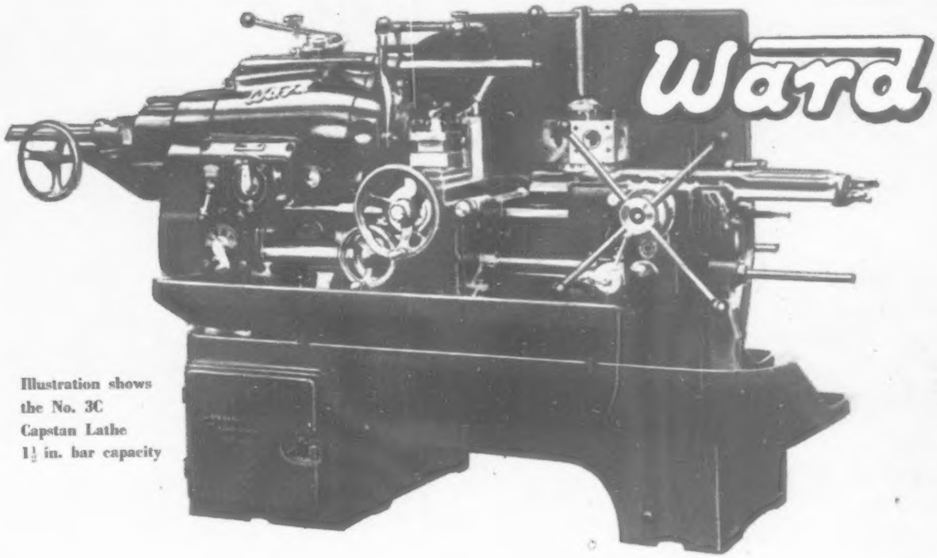

Illustration shows the No. 3C Capstan Lathe 1½ in. bar capacity

Many new features include
12 spindle speeds – both forward and reverse
Higher centres giving increased swing
Bed protected by stainless steel covers
Inbuilt electrical equipment
Large capacity swarf pan

Full details of our complete range of Capstan and Turret Lathes on request.

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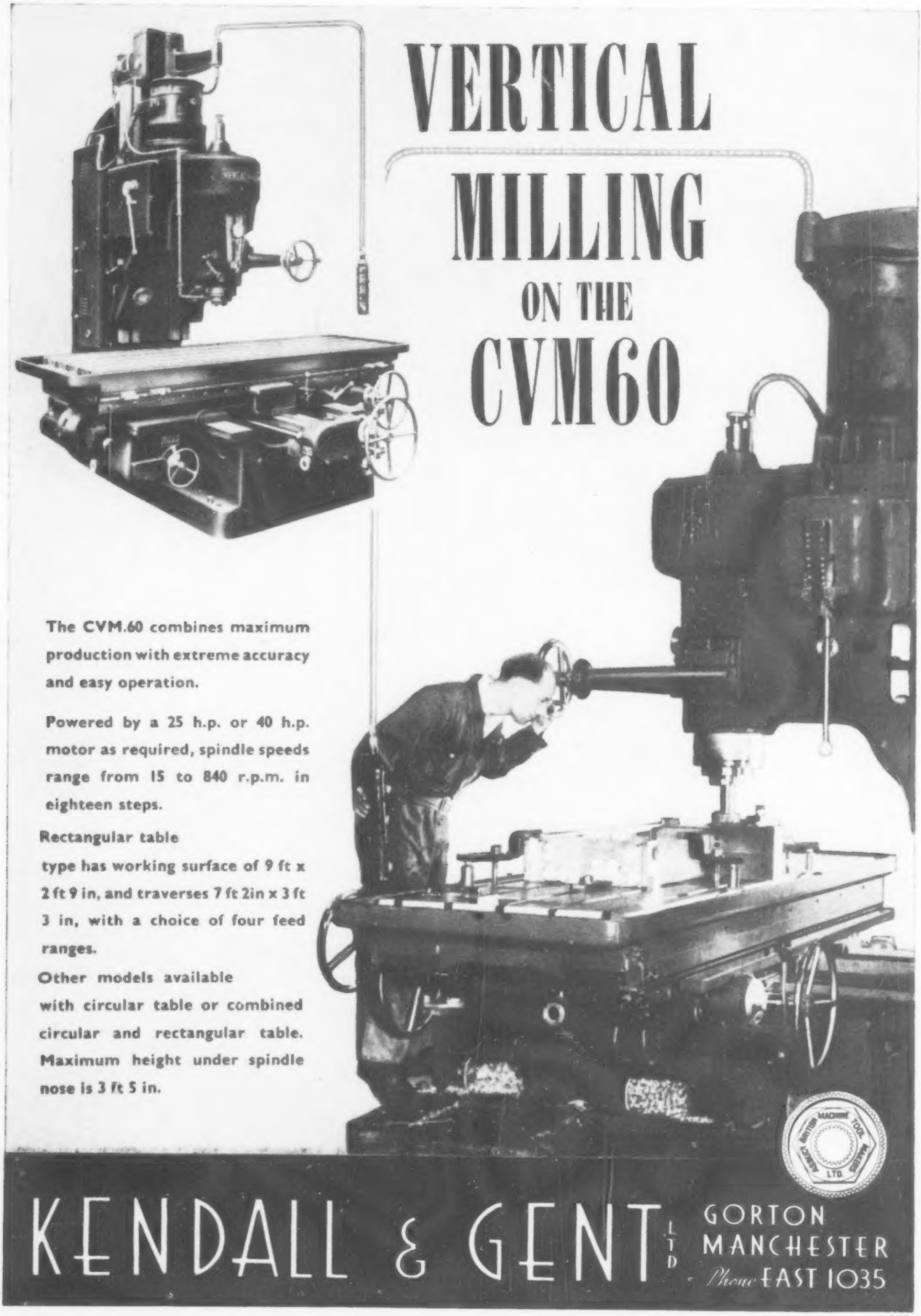
BRITISH MACHINE TOOL MAKERS ASSOC. LTD

W670



VERTICAL MILLING ON THE CVM60

The CVM.60 combines maximum production with extreme accuracy and easy operation.

Powered by a 25 h.p. or 40 h.p. motor as required, spindle speeds range from 15 to 840 r.p.m. in eighteen steps.

Rectangular table type has working surface of 9 ft x 2 ft 9 in, and traverses 7 ft 2in x 3 ft 3 in, with a choice of four feed ranges.

Other models available with circular table or combined circular and rectangular table. Maximum height under spindle nose is 3 ft 5 in.

KENDALL & GENT LTD
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K247

FBC SPECIALS

. . . the key to a fuller life

Performance in many branches of engineering is getting very intensified, and what once passed as normal bearing practice is now as inadequate as a wooden wheel on a 100 m.p.h. car.

Some machines start out by packing enormous power into a small and often hot space, and there—as in some of the finest jet engines in the world—you will find FBC 'Specials' often running at fantastic speeds.

Other machines in the course of time get 'hotted up' to give far greater power or output—yet it is seldom that the original design has the space to take bigger bearings.

Here again FBC 'Specials' are saving the situation—for it is amazing what exacting duties can be carried out by the right kind of bearing, when one is really 'up against it' and enlists the aid of the right people.

Our engineers—to whom, of course, we have just referred—will always assist in the design and manufacture of 'Specials' to suit customers' problems.

FISCHER BEARINGS CO. LTD., WOLVERHAMPTON

Fischer Bearings Company Ltd., and Timken-Fischer Stockists Ltd., Birmingham, are both subsidiaries of British Timken Ltd.

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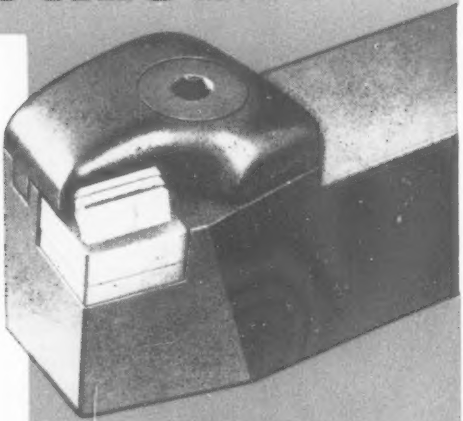
SANDVIK Coromant PRESENT



THE

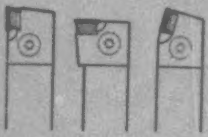
Coromant T-MAX

PAT PEND

THROW-AWAY TOOL HOLDER

- * Simple
- ** Sturdy
- *** Compact
- **** Efficient
- ***** Exclusive spring lifted three step chipbreaker

The new T-MAX provides an indexible and invertible insert, which is securely held and seated on a reversible carbide anvil, chamfered to ensure good tip seating even when the insert's edges are built up. The inserts are available in a range of thicknesses and radii in precision ground or utility finishes.

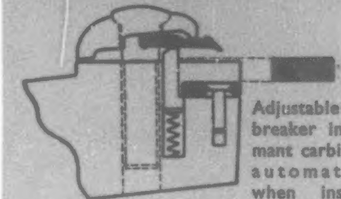


3 types as shown

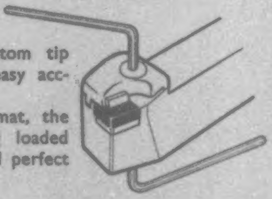
2 sizes: 1 in. x 1 in. and 1½ in. x 1 in. Right and Left hand

"MECHANICAL TUBING"

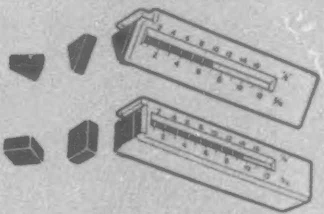
Incidentally, why not use Sandvik Mechanical Tubing for your sleeve or ring shaped components.



Adjustable chip-breaker in Coromant carbide, lifts automatically when insert is released for indexing or changing. No loose parts to fall out in awkward places.

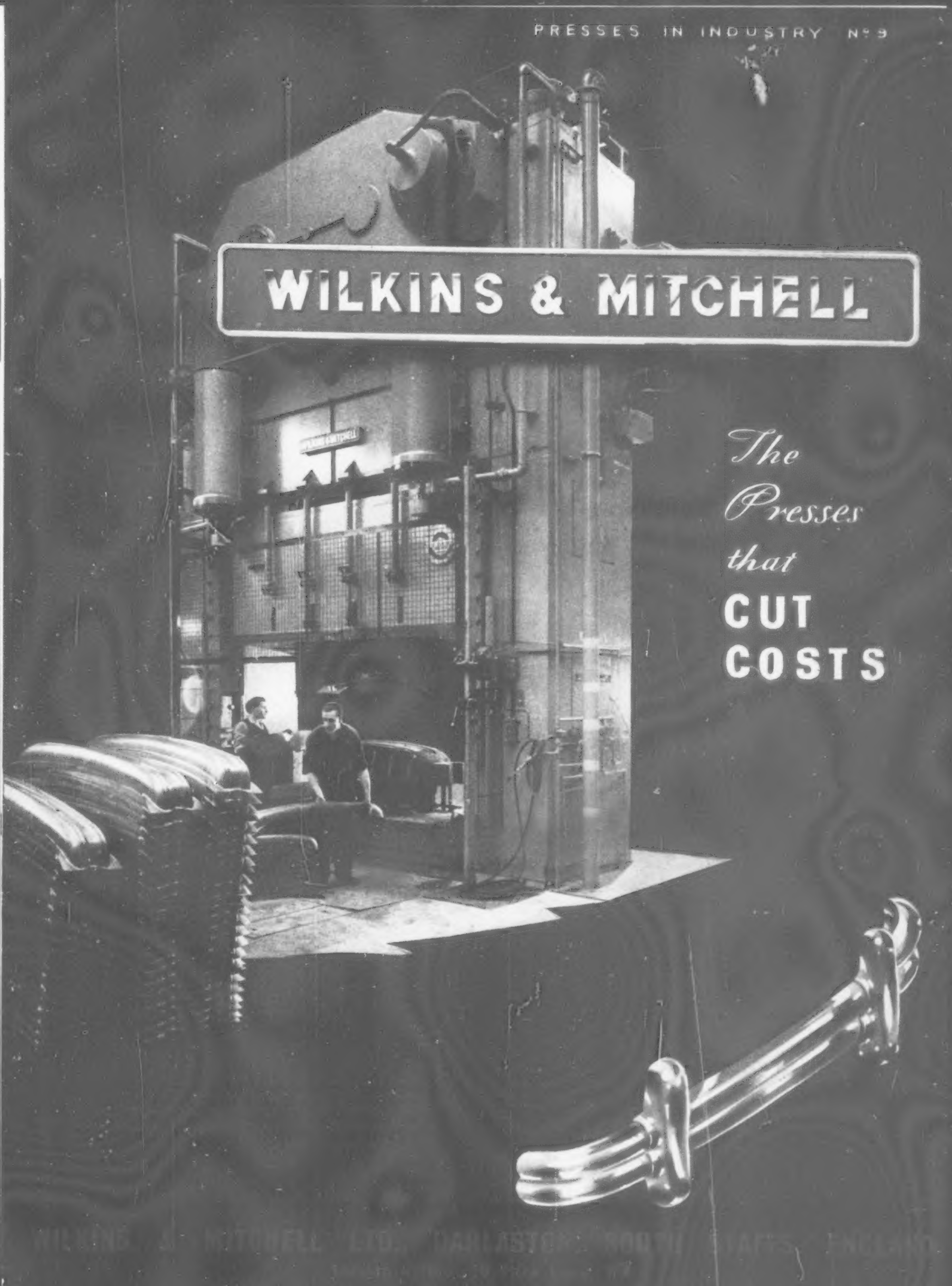


Top or bottom tip release for easy accessibility.
T-Max Automat, the handy spring loaded dispenser and perfect tip package.



Send now for free T-Max Booklet

SANDVIK SWEDISH STEELS LIMITED
MANOR LANE • HALESOWEN • BIRMINGHAM
Telephone: Halesowen 2121 (7 lines)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The Presses that
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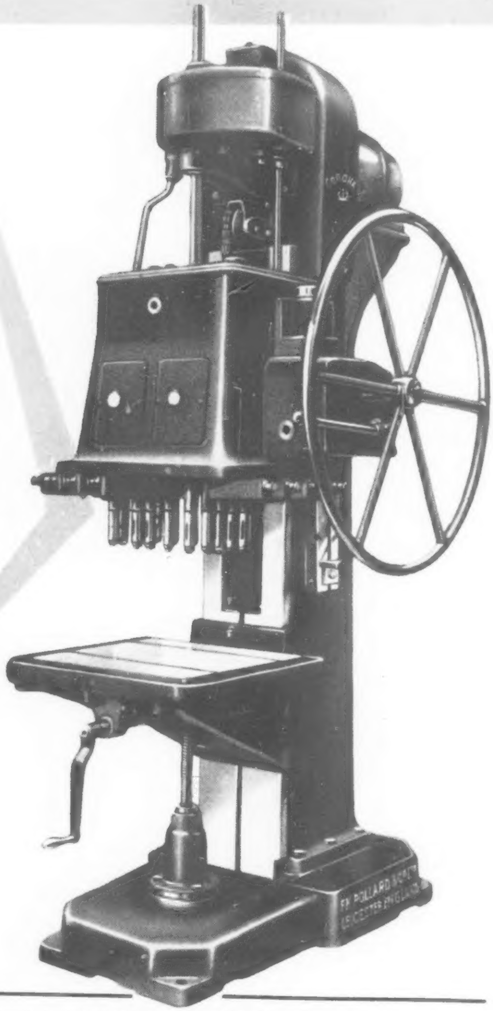
WILKINS & MITCHELL LTD., DARLASTON, SOUTH STAFFS, ENGLAND

For Maximum Drilling Capacity on Rigid Production Schedules

CORONA Multiples



MODEL 16 MX

16 SPINDLE VERTICAL DRILLING MACHINE
WITH ADJUSTABLE SPINDLES

Minimum Centres $1\frac{1}{4}$". No. 1 M.T. Drilling Area 16"x10"

EXAMPLE OF CAPACITY

16-$\frac{5}{16}$" dia. DRILLS OR 8-$\frac{1}{2}$" dia. DRILLS

MADE IN FIVE SIZES

LARGEST: CAPACITY 24-$\frac{9}{16}$" dia. DRILLS
SMALLEST: CAPACITY 6-$\frac{3}{16}$" dia. DRILLS

ALL MACHINES CAN BE SUPPLIED FULLY TOOLED READY FOR PRODUCTION

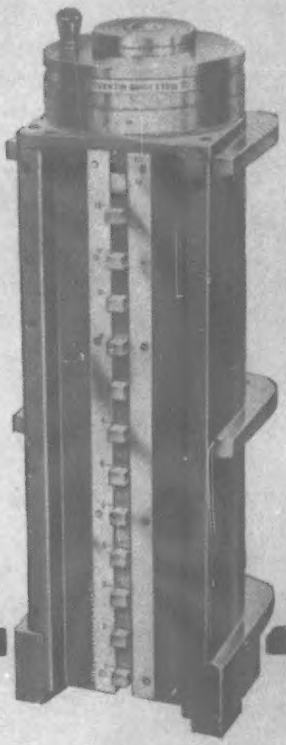
FREDK. POLLARD & CO., LIMITED
CORONA WORKS, LEICESTER, ENGLAND
TELEPHONE: LEICESTER 67534 (5 Lines)

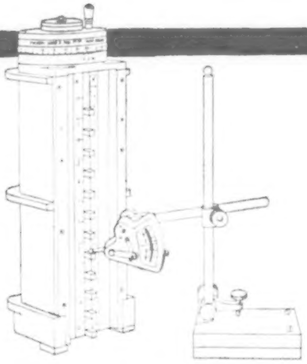
London Office: COASTAL CHAMBERS, 15, ELIZABETH ST., BUCKINGHAM PALACE RD., S.W.1
TEL: SLOANE 8880
Scottish Representatives: WALTER S. LANG & CO., 48, OSWALD STREET, GLASGOW, C.1
TEL: CENTRAL 2539

Height Setting Micrometer

1. Height settings and measurements from surface tables and machine tables can be taken without the use of separate slip gauges.
2. The instrument is virtually a permanent yet variable slip gauge combination, ready for use at a moment's notice.
3. Wear and tear on normal slip gauges previously used for this purpose, can be considerably reduced and a marked saving in replacements will be made quickly apparent

MATRIX **METROLOGY GROUP**





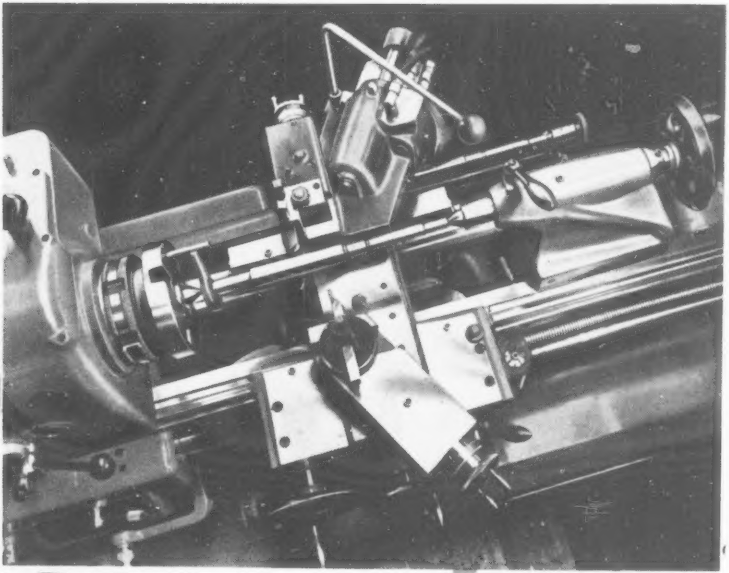
Setting the Indicator to the nominal height for a dimension to be checked

4. Vertical slide carries a standard set of slip gauges which are wrung together to give increments of 1.0000" from zero to 12"
5. Movement of slide controlled by micrometer graduated in 0.0001" divisions with vernier reading to 0.00001"
6. To check components beyond the height capacity of the instrument, 6" risers can be supplied upon which the instrument locates and stands.
7. A model suitable for the metric system is available.

Coventry Gauge

& TOOL COMPANY LTD MATRIX

P.O. BOX 39, COVENTRY, GT BRITAIN

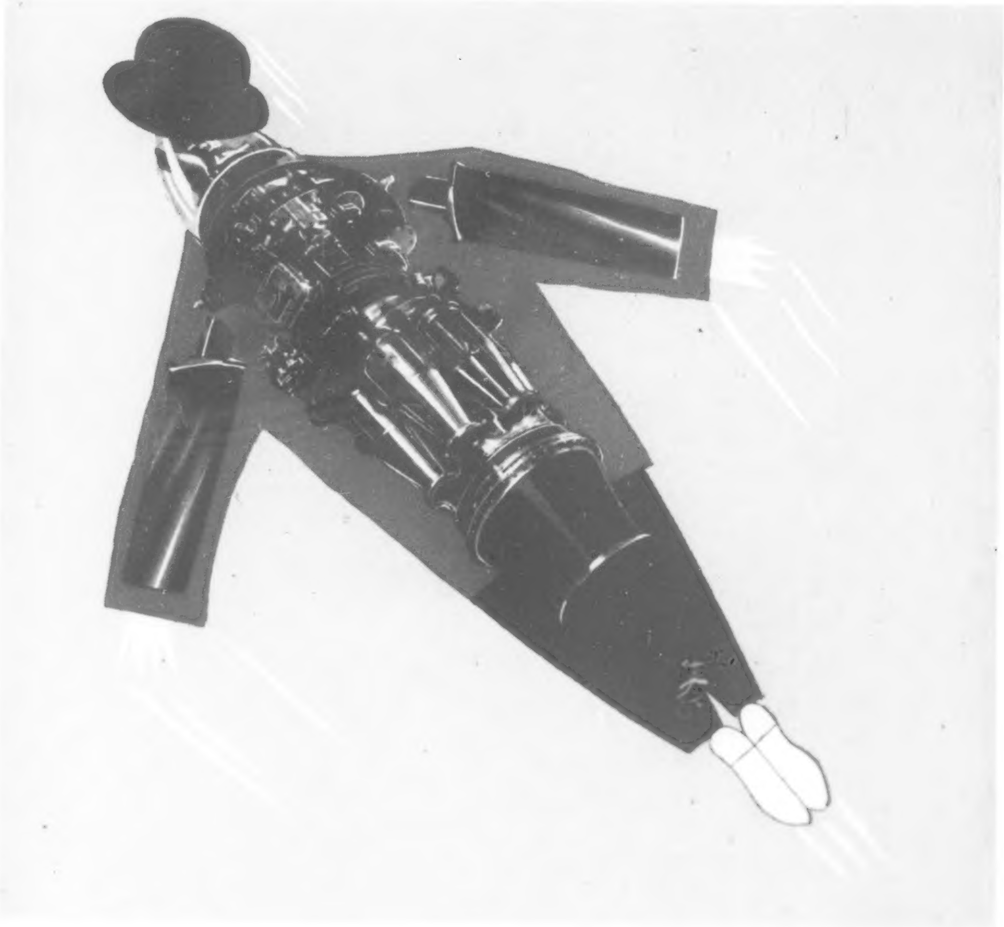


The
HEPWORTH

'250' TYPE LATHE COPYING UNIT FITTED AS STANDARD TO THE COLCHESTER STUDENT LATHE

Does not impede the normal use of the lathe in any way. Fine tapers and radii readily copied and close tolerances maintained. The above illustrations show typical multi-stepped shaft copy machined

NOTE — APPOINTED AGENTS FOR THE SUPPLY OF



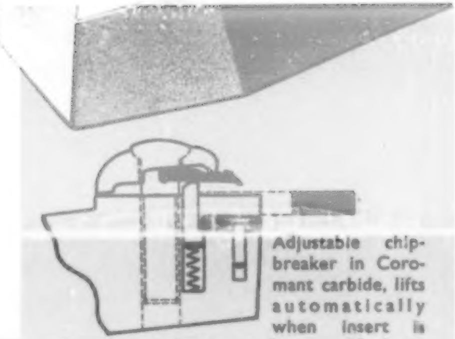
Up in the air about Alloy and Special Steels?

Here your experience will tell you that in Alloy and Special Steels quality is of primary

specify Alloy and Special Steels produced by Low Moor Alloy Steelworks Limited. These steels

TOOL HOLDER

Simple
Sturdy
Compact
Efficient
Exclusive spring
lifted three step
chipbreaker



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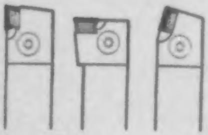

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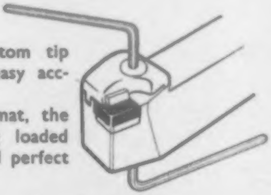

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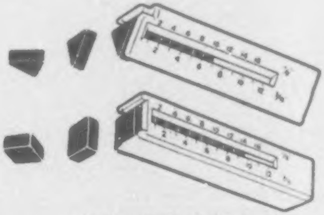

Send now for free T-Max Booklet

"MECHANICAL TUBING"
Incidentally, why not use Sandvik Mechanical Tubing for your sleeve or ring shaped components.

SANDVIK SWEDISH STEELS LIMITED

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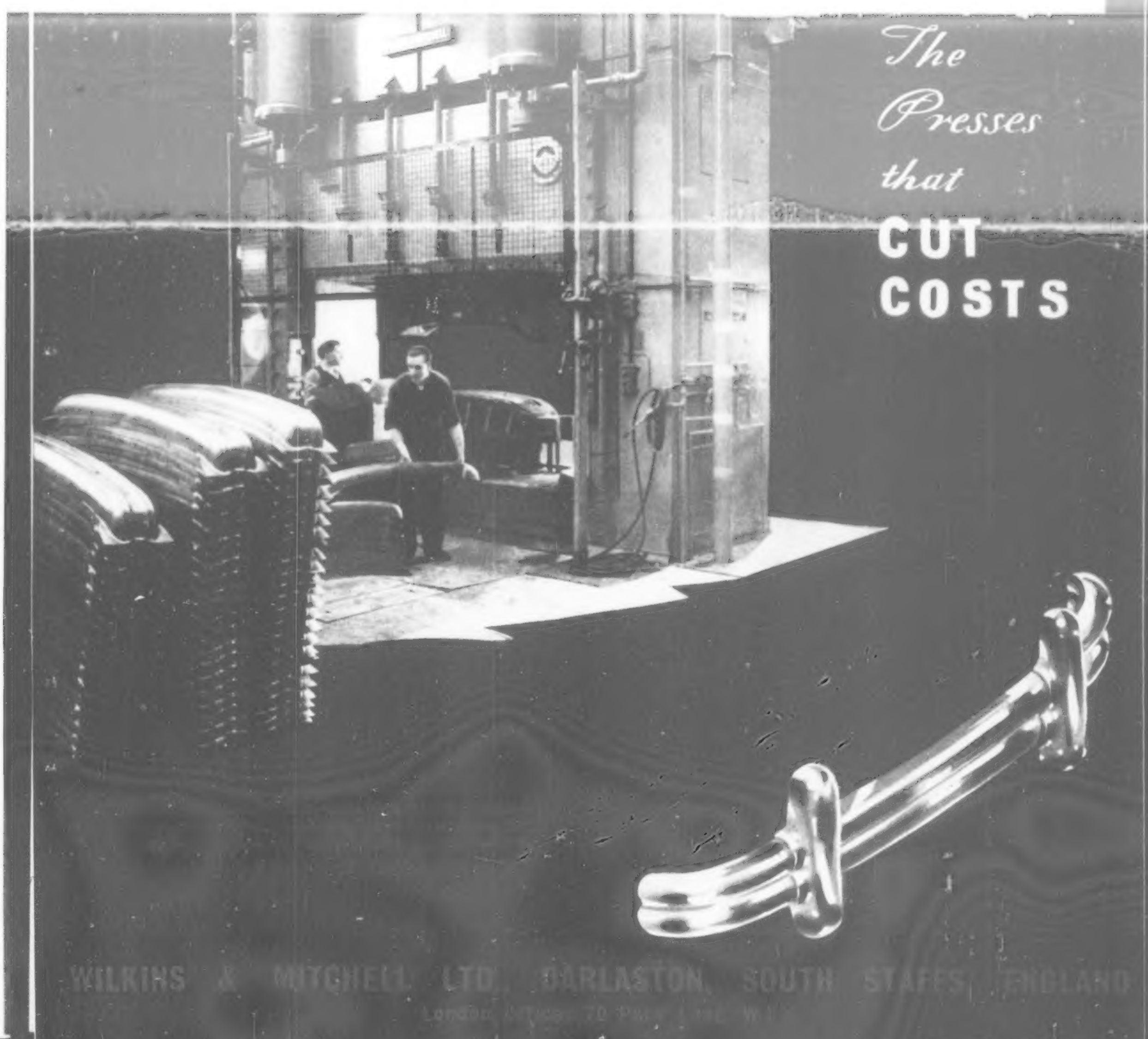
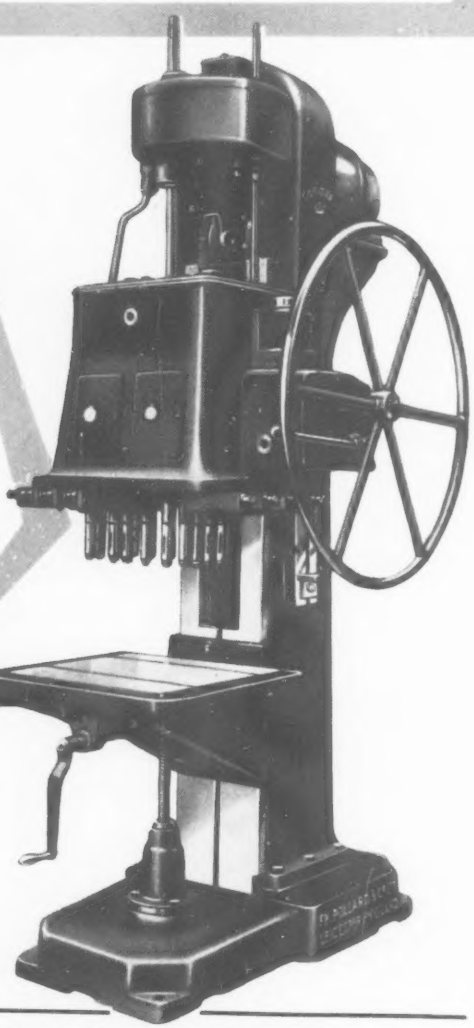
importance. For this reason many world famous Aircraft and Aero Engine Manufacturers

are A.I.D. and A.R.B. approved. Full technical details are available


The Presses that CUT COSTS

WILKINS & MITCHELL LTD., DARLASTON, SOUTH STAFFS, ENGLAND
London Offices: 70 Park Lane, W.1

For Maximum Drilling Capacity on Rigid Production Schedules



CORONA Multiples

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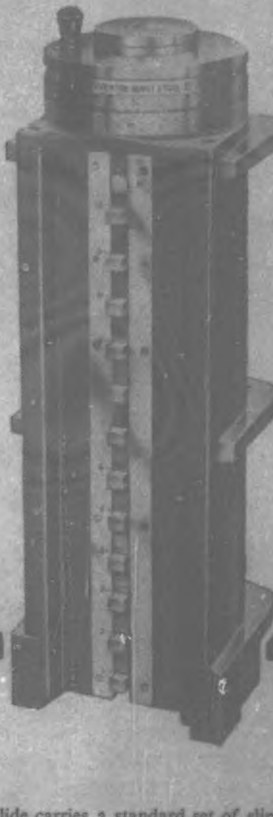
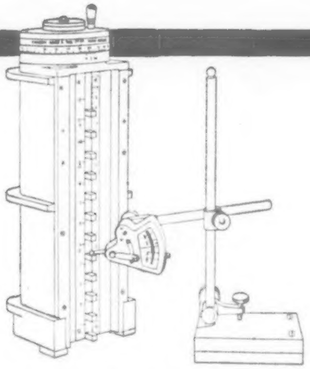
METROLOGY GROUP





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Coventry Gauge

& TOOL COMPANY LTD

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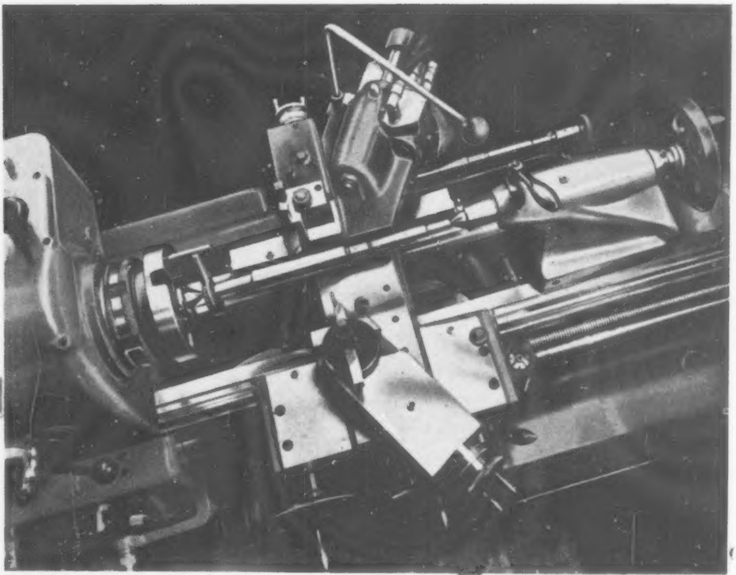

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Does not impede the normal use of the lathe in any way. Fine tapers and radii readily copied and close tolerances maintained. The above illustrations show typical multi-stepped shaft copy machined

NOTE— APPOINTED AGENTS FOR THE SUPPLY OF THE COMPLETE COLCHESTER STUDENT COPYING LATHE AT ONLY £574

THE HEPWORTH IRON CO (ENG) LTD HAZLEHEAD NR SHEFFIELD

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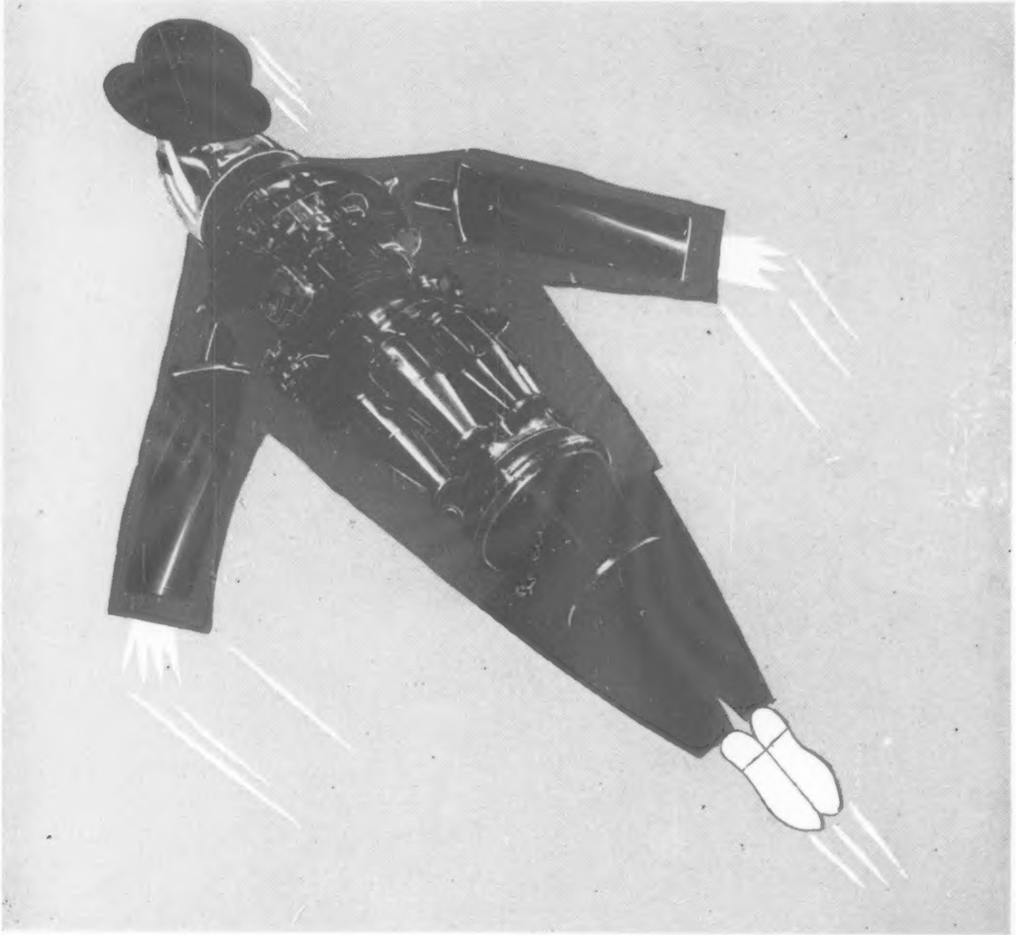

Up in the air about Alloy and Special Steels?

. . . then your experience will tell you that in Alloy and Special Steels, quality is of primary importance. For this reason, many world famous Aircraft and Aero Engine Manufacturers specify Alloy and Special Steels produced by Low Moor Alloy Steelworks Limited. These steels are A.I.D. and A.R.B. approved. Full technical details are available on request.

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ALLOY STEELWORKS LIMITED

for EXTRUSIONS: Low Moor Fine Steels Ltd.

for ALLOY and
SPECIAL STEELS
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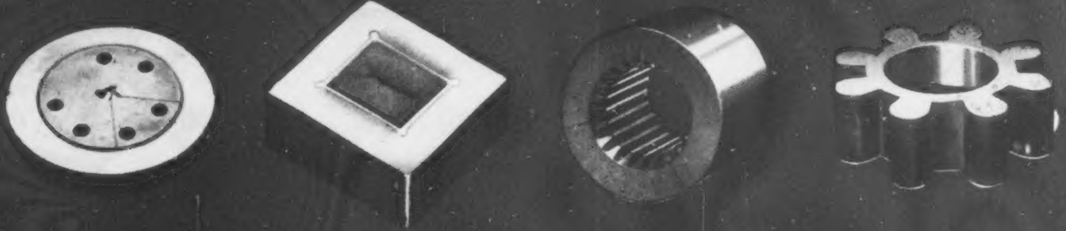

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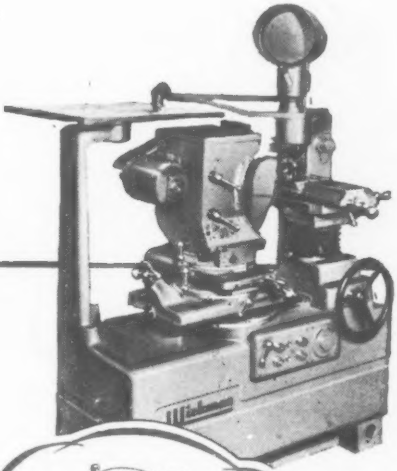
When versatility and accuracy are important . . . .

The range of application possible on the Wickman Optical Profile Grinding Machine is well-nigh limitless. And because templates and formed wheels are not required, single components can be produced quickly with the minimum risk of lost accuracy.

Many years' experience with operators possessing varying degrees of skill has shown that with normal attention forms can be produced to a reliable plus or minus tolerance of 0.0005″ and with special care to within 0.0002″.



. . . here's the answer to form grinding problems

OPTICAL PROFILE GRINDING MACHINE

WICKMAN LIMITED

MACHINE TOOL DIVISION, BANNER LANE, COVENTRY
Telephone: Tile Hill 65231

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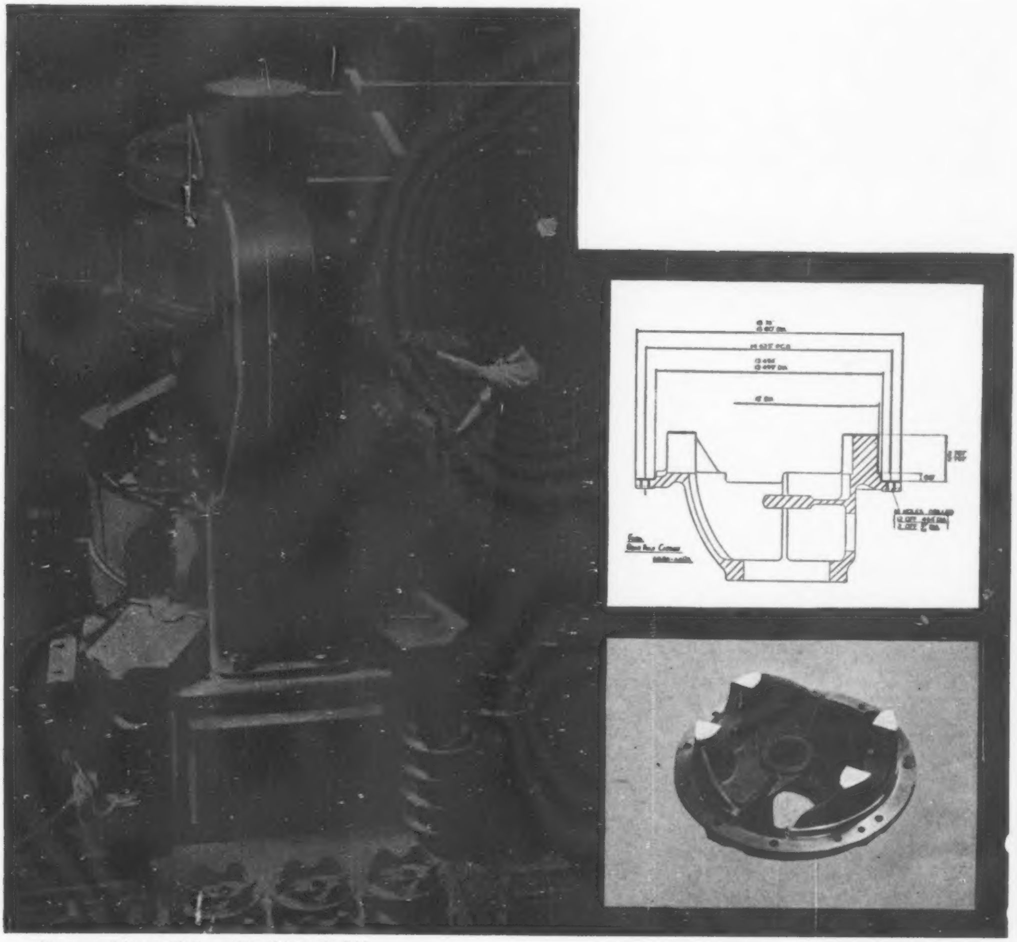
ECLIPSE
10 TEETH
HIGH SPEED STEEL

USE Eclipse HACKSAW BLADES

and feel the difference!

'Eclipse' hacksaw blades and other tools are made by James Neill & Co. (Sheffield) Ltd., and are obtainable from all tool distributors.

UH27



Photograph by permission of Ford Motor Co. Ltd.

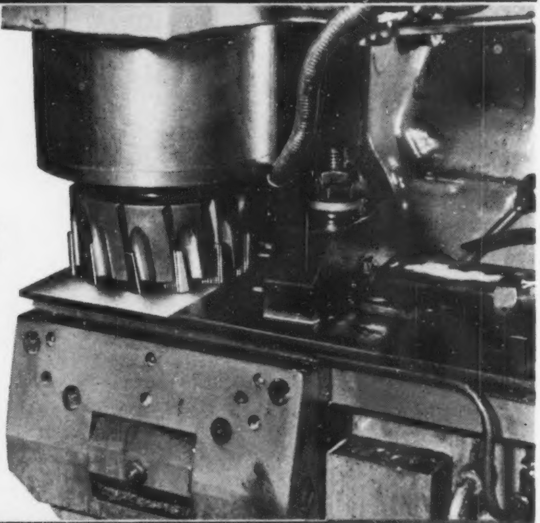
Machining of Ford rear axle carriers

This six-spindle No. 10 Verticalauto multi-drills fourteen holes in the component as well as turning and facing. Hydraulic chucks exert a controlled pressure grip ensuring that there is no distortion. A 60 h.p. main motor provides ample power for continuous high production. *8 and 12 spindle models are also available.*

Ryder VERTICALAUTO

Thos. Ryder & Son Limited, Turner Bridge Works, Bolton, England
Makers also of single-spindle Rydermatics and Piston Ring Lathes

5 weeks between regrinds!



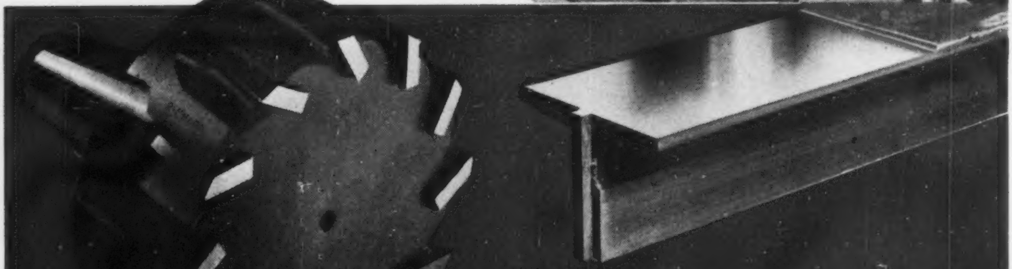
Galtona

TRADE MARK

O-K

SERRATED BLADE CUTTERS

. . . . SET REMARKABLE PERFORMANCE RECORDS AT BRITISH GUIDE RAILS LTD.



This "Galtona-O-K" [illegible] Blade High Speed Cutter 9½ in. diameter, with [illegible] [illegible] Ltd. [illegible] [illegible] to a fine [illegible] [illegible] this state [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] *[illegible] performance [illegible]* *Why not consult our Tool [illegible]?*

Richard Lloyd Limited

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Telephone: Ashfield 1801, Telegrams "Cogs, Birmingham"

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When answering advertisements kindly mention MACHINERY.

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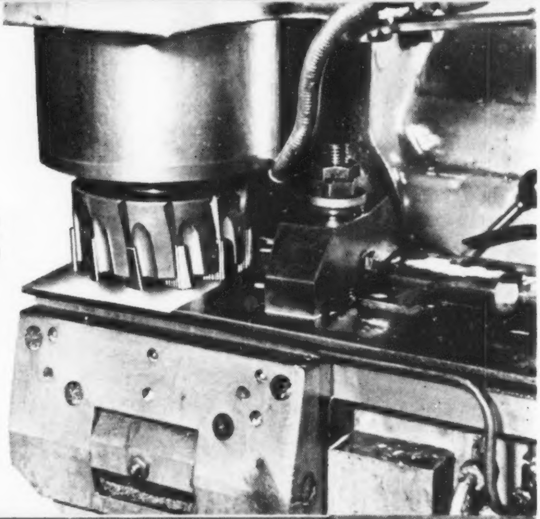
MSL
Also consult us for . . . . . ducting . . . storage tanks . . . mild steel fabrications etc.

5 weeks between regrinds!

Galtona
TRADE MARK
O-K



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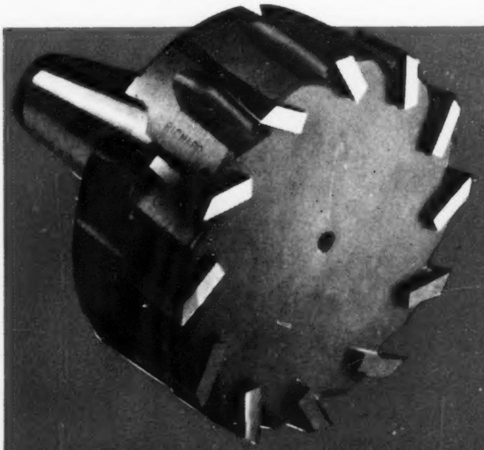

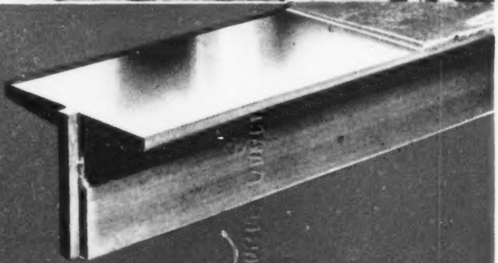

This "Galtona-OK" Serrated Blade High Rake Cutter, 6½ in. diameter, with twelve blades in T.15 high speed steel, has set up a fine record of performance on the milling of fish plate pads on passenger lift guide rails. Speed is 160 r.p.m., (272 f.p.m.) with a feed of 8 in. per min., and depth of cut ¼ in. ***"Galtona-O.K." serrated blade cutters could show improved performance on your own work. Why not consult our Tool Engineers?***

Richard Lloyd Limited

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Telephone: Ashfield 1801, Telegrams "Cogs, Birmingham"

NORTHERN AREA OFFICE: A. V. Green, Britannia House, Wellington Street, Leeds, 1. **Phone: Leeds 2121**
LONDON AREA OFFICE: A. J. Percy, 240 Romford Road, Forest Gate, London, E.7. **Phone: MARyland 7304-**
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Mechanical [illegible]

does you a good turn...

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Also consult us for .. ... ducting ... storage tanks ... mild steel fabrications etc.

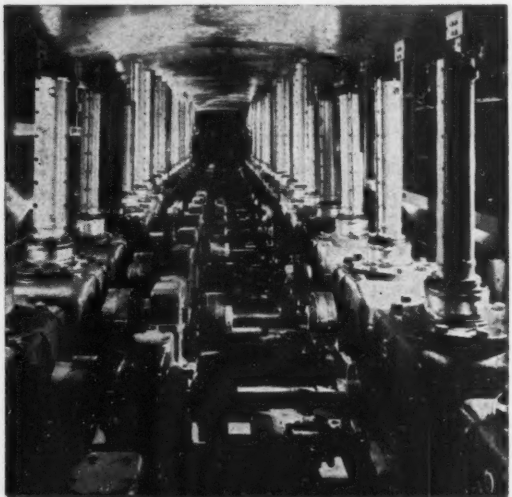
Markland Scowcroft LTD

COX GREEN WORKS, BROMLEY CROSS, Nr. BOLTON.

Tel. Eagley [illegible] ([illegible] lines)

BIG JOBS

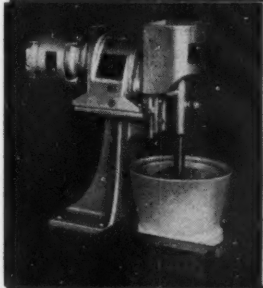
—such as supplying many special worm reduction gear units to the Royal Aeronautical Establishment for the supersonic wind tunnel at Bedford are not new to us here at Newbury, for besides non-standard units, our normal range of worm and spur units covers practically all industrial applications up to 120 h.p.



Type WGV 5½ single reduction worm gearbox driven b WGV 4½ single reduction gearbox. As supplied to the Roy Aeronautical establishment, Bedford, for use in the 8 f supersonic wind tunnel. The photograph shows part of th assembly of the worm drive section of the tunnel.

AND SMALL JOBS

— such as the production of a small gear unit for an experimental pan and muller for grinding colours is another example of our standard range. Our compact, robust helical and spur geared motors are available as double or triple reduction units in six sizes, offering a complete range of horsepowers and output speeds to the user. You can't go wrong if you specify —



Laboratory colour Pan driven by a ½ h.p. drip proof geared motor unit, Type S.G.M.I. Ratio 22 :1. Output speed 65 r.p.m. This photograph is reproduced by permission of William Boulton Limited Burslem, Staffs.

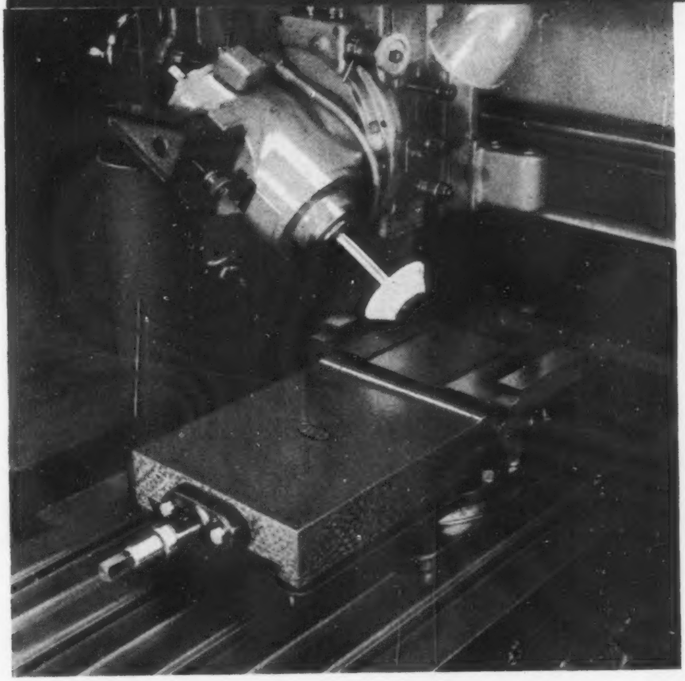
ype SUH horizontal shaft, fan oled worm reduction gear. Standard sizes up to 12 in. centres; nonndard sizes up to 24 in. centres. atios 3 : 1 to 100 : 1.

GEARBOXES by OPPERMANS

# of NEWBURY

OPPERMAN GEARS LIMITED, NEWBURY, B [illegible]

For Accuracy Plus Durability



Grinding Vee Slides of drill jig using Abwood Machine Vice for ease of set-up. This set-up precludes any possibility of lift, thus ensuring all faces being square and/or parallel.

THE ABWOOD MODERN MACHINE VICE

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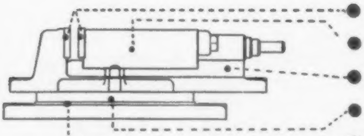

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MV-2

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Recommend we specify DYSON'S diecastings for use in this new design — we proved them on the last job

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incorporate many interesting features including

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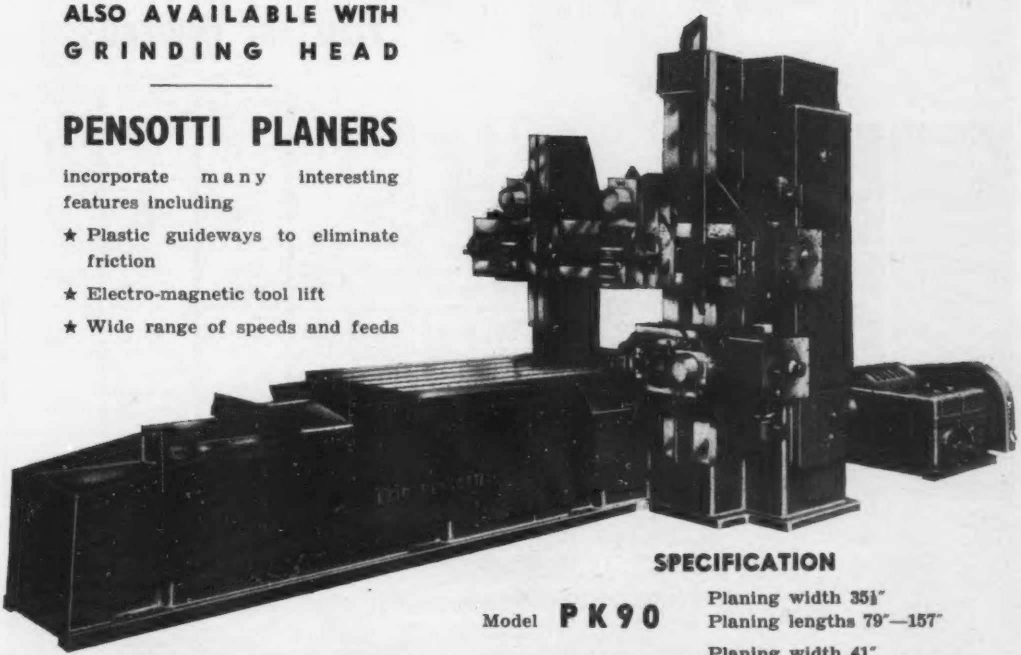

SPECIFICATION

Model	Planing width	Planing lengths
PK90	35¼"	79"—157"
PK105	41"	78"—197"
PK125	49"	98"—236"

NRP 2164

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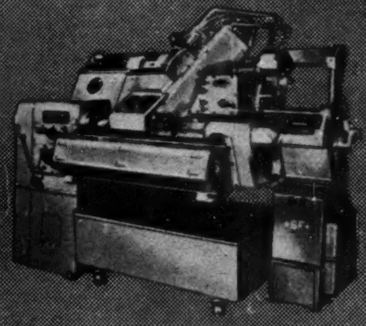

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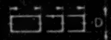
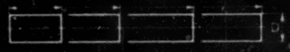
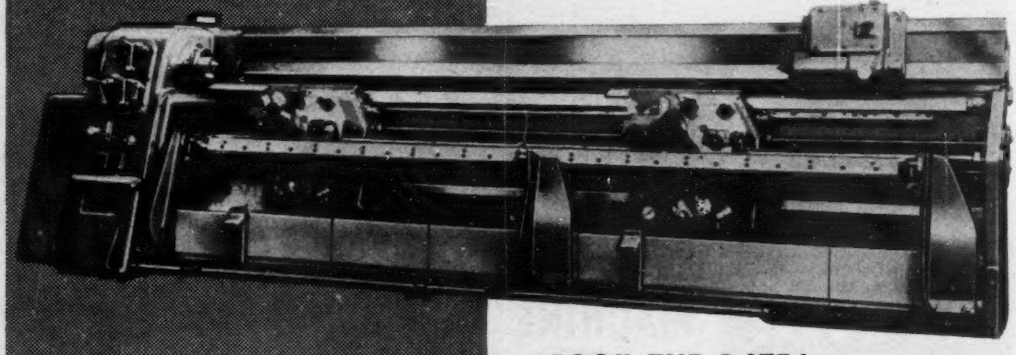
		Maximum turning length L mm (in)				Maximum turning dia. D mm (in)		Maximum swing dia. mm (in)		Power HP	
KDM-7		500 (20)	650 (26)			140 (5,5)		330 (13)		13	
KDM-11		400 (16)	700 (28)	1000 (40)		225 (8,85)		315 (12,4)		20	
KDM-18		700 (28)	1500 (60)	2500 (100)	3500 (138)	355 (14)		440. (17,3)		25	
KDM-18-25		700 (28)	1500 (60)	2500 (100)	3500 (138)	355 (14)		590 (23,2)		25	
KDM-18-K		700 (28)				355 (14)		700 (28)	840 (33)	25	
KDM-F		170 (6,7)	600 (24)	1000 (40)		420 (16,5)	560 (22)	630 (24,8)		25	30



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as these fine machines are now a product of the Elliott Group.

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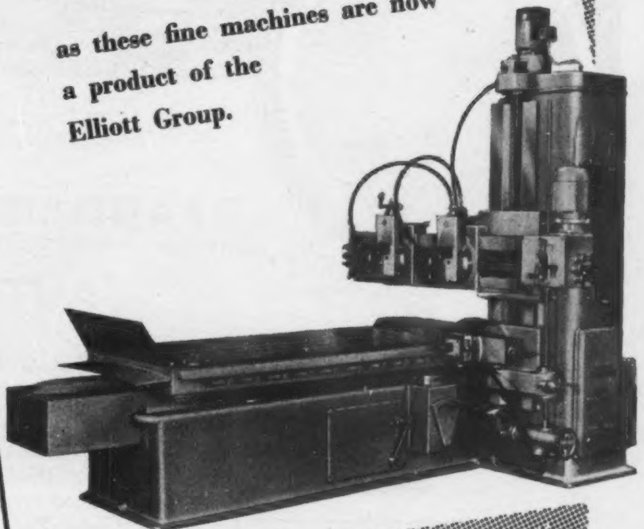

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The 'Bijur' system fitted to an Archdale Transfer machine at the Standard Motor Company's Banner Lane Factory.

STANDARD
MOTOR COMPANY LIMITED
AUTOMATION
uses Tecalemit Lubrication

At the Standard Motor Company's Banner Lane factory in Coventry, the "Tecalemit-Bijur" Lubrication System is fitted to the three Archdale Multi-Station Transfer machines. These machines are used for machining the transmission housings for 100,000 Massey-Ferguson tractors each year.

Three "Tecalemit-Bijur" Lubricating Pumps are fitted to each machine, providing a measured quantity of oil for 170 lubrication points, at correct intervals, through calibrated metering valves. The "Tecalemit-Bijur" System, protects every bearing surface of the machine with a film of clean oil.

Tecalemit lubrication increases production time by doing away with oiling shut-downs, and by prolonging the life and precision of the machines. There's no oil wastage and maintenance costs are considerably cut.

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SURFACE GRINDING

is periphery grinding at its best. A large dia. wheel is used and fed across the work rapidly, spreading the cutting load over a wide area of the wheel, resulting in smooth and fast metal removal and low wear.

Non-compound table allowing a solid support in any position. Direct spindle drive avoiding loss of power. Special paraffin lubricated bearings running with the very minimum of play. Heavy cross-moving wheel head column assuring constant accuracy.

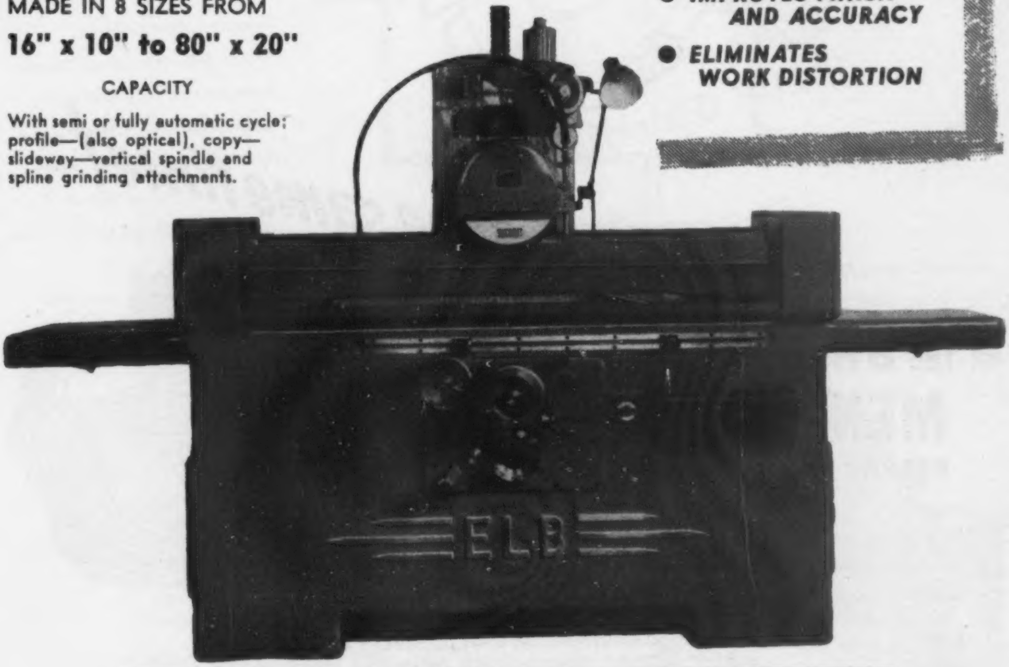
- **CUTS COSTS**
- **SPEEDS OUTPUT**
- **IMPROVES FINISH AND ACCURACY**
- **ELIMINATES WORK DISTORTION**

MADE IN 8 SIZES FROM

16" x 10" to 80" x 20"

CAPACITY

With semi or fully automatic cycle: profile—(also optical), copy—slideway—vertical spindle and spline grinding attachments.



You are cordially invited to a demonstration of new and reconditioned grinding machines at Soag's Battersea Showrooms

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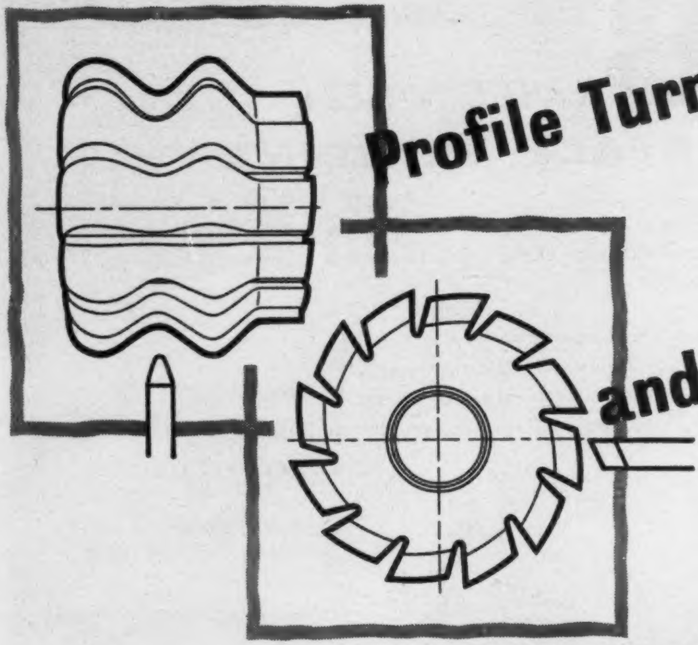
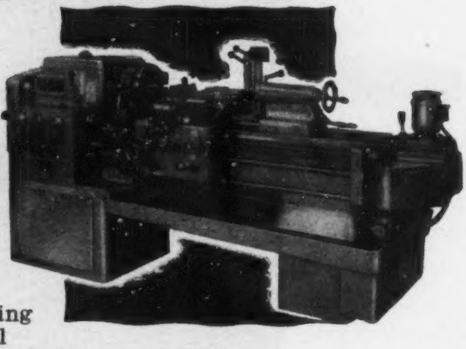


Profile Turning and Relieving -at the same time!



ON THE SWISS MENZIKEN M200 HYDROCOPYING RELIEVING LATHE

ALSO
(non-relieving)

Model		Centre height
J.390	...	7¼″
M.270	...	10½″
M.300	...	11⅞″

Simultaneous hydrocopying and longitudinal or radial relieving. Copies from simple flat or cylindrical masters. Single-point tool produces wide forms easily. Lever disconnects relieving mechanism for normal turning and screw-cutting. Centre height 7⅞″, 30″, 40″ or 60″ between centres.

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IN THE SAME TEST—

THIS END WAS TWISTED...

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This test-piece proves that for mechanical drives—press, push, or sliding fit—Polygon form provides greater torsional strength. There's no 'notch effect' and no 'run-out'. One machine completes the job—external and internal, roughing and finishing. Ellipses and squares can also be produced and grinding wheel wear has no influence on profile. Eccentrics can be produced on a single pair of centres. A lever disconnects the generating drive for normal cylindrical grinding.

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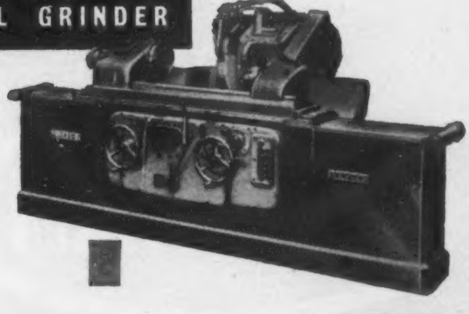
The technical brochure is most interesting — why not write for one?



CYLINDRICAL GRINDING

Max. external dia. *4.33". Max. internal dia. 11.7".

TRIANGLES

Max. difference inscribed and circumscribed circles .788". Max. external dia. *4.33". Max. internal dia. *4.33". Distance between centres 31½".

* Figures given for 17" wheel. Can be increased with wheel of smaller diameter.

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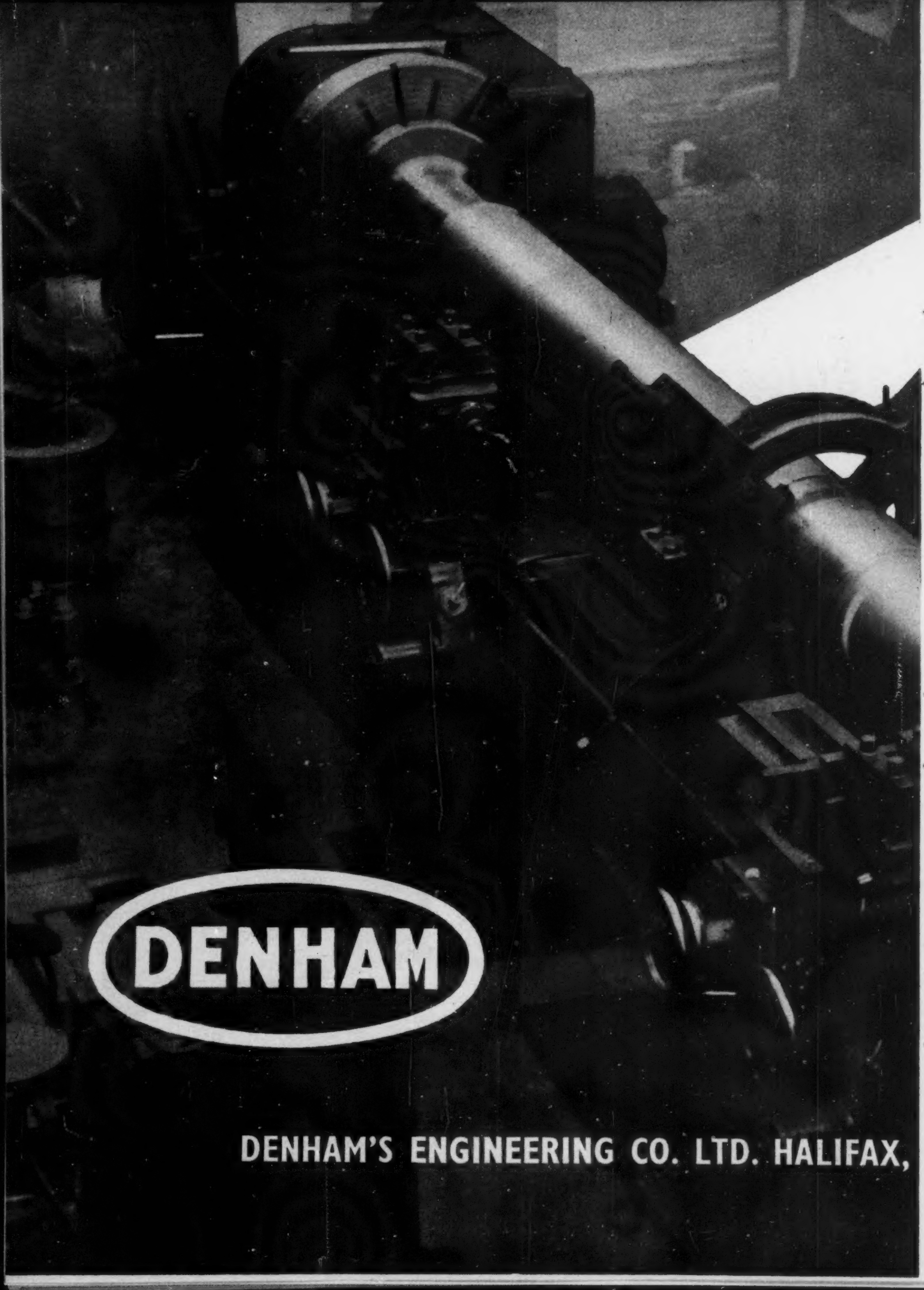
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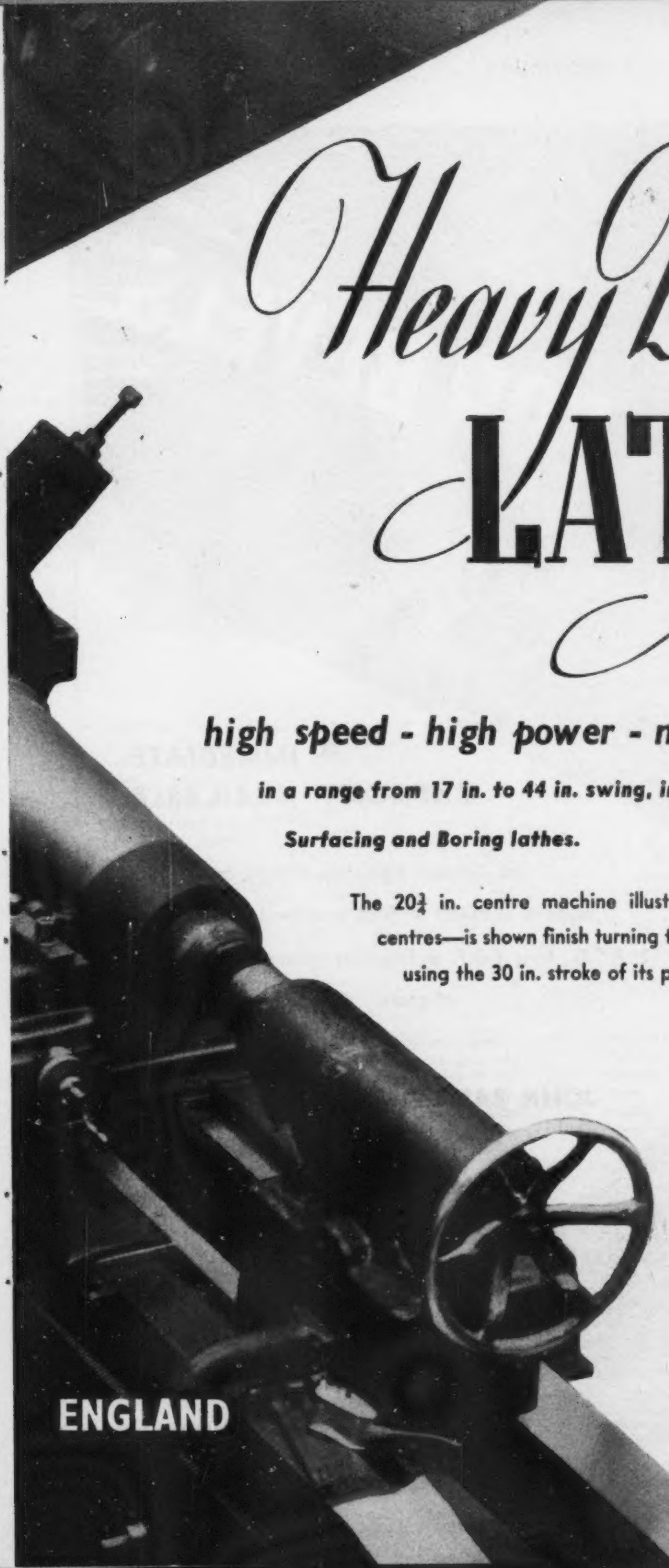
DENHAM'S ENGINEERING CO. LTD. HALIFAX,



Heavy Duty LATHES

high speed - high power - massive construction

in a range from 17 in. to 44 in. swing, including 17 in. and 25 in. swing.

Surfacing and Boring lathes.

The 20¾ in. centre machine illustrated—admitting 32 feet between centres—is shown finish turning the taper of a marine propeller shaft, using the 30 in. stroke of its power operated tool slide.

Photo by courtesy of
The Sunderland Forge & Eng'g. Co. Ltd.

ENGLAND

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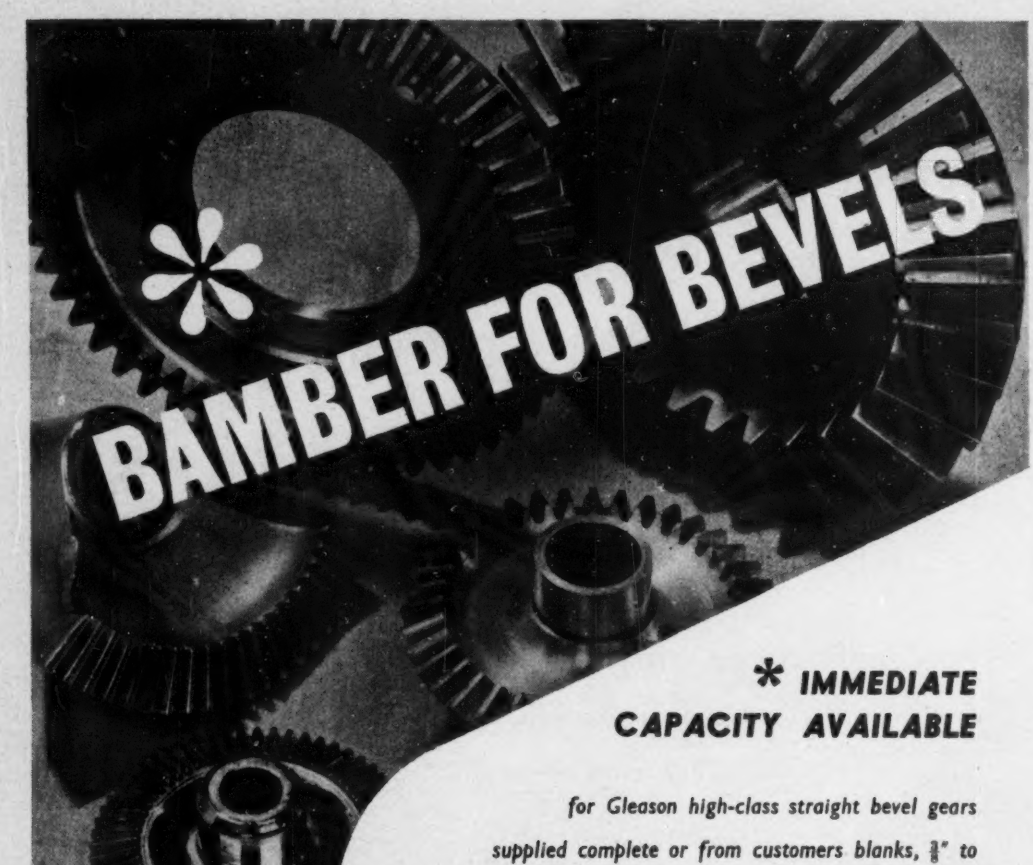

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for Gleason high-class straight bevel gears supplied complete or from customers blanks, $\frac{3}{8}$" to 12" P.C.D., 48 to 4 D.P. ● Enquiries welcomed for all types of gears. Call, write or telephone.

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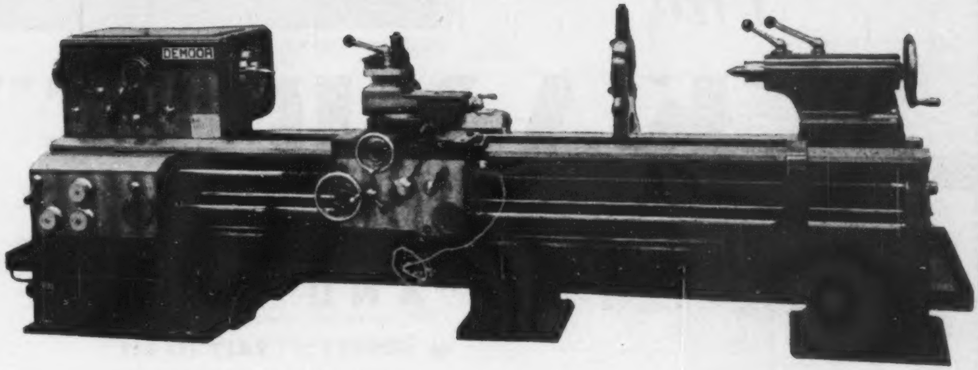
DEMOOR *Heavy Duty* LATHES



"DEMOOR" LATHES type	821	822	823	824	825	826	827
CAPACITY:							
Height of Centres	8¾"	11"	14"	15¾"	17¾"	18¾"	19¾"
Maximum swing over bed	19¼"	23¼"	29½"	34¾"	38¼"	40"	41¾"
Maximum swing over saddle	12"	15¾"	21¼"	23⅝"	27⅝"	29½"	31½"
Hole through spindle	2"	3⅛"	3⅛"	4"	4"	4"	4"
Number of speeds	2 x 9=18	2 x 12=24	2 x 18=36	2 x 18=36	2 x 18=36	2 x 18=36	2 x 18=36
Maximum and minimum r.p.m. ... ... 2nd range	25-1000	12-530	10-500	10-500	10-500	10-500	10-500
Maximum and minimum r.p.m. ... ... 1st range	31.5-1250	20-900	14-710	14-710	14-710	14-710	14-710
Admits between centres	3' 4" to 8' 3"	5' to 13' 2"	6' 7" to 16' 5"	6' 7" to 19' 10"	6' 7" to 19' 10"	6' 7" to 19' 10"	6' 7" to 19' 10"

The Demoor 'Magic Eye' series of high-speed heavy-duty lathes embodies a range of remarkable features which have won for it an exceptional reputation. These features ensure the greatest output of close tolerance work, perfect finish and very easy operation. There is a full power capacity for tungsten-carbide or negative rake tools.

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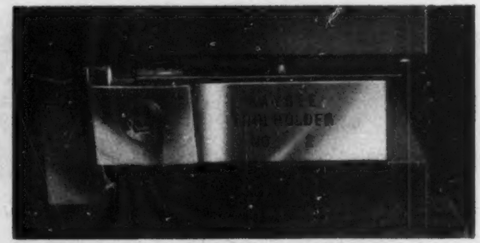

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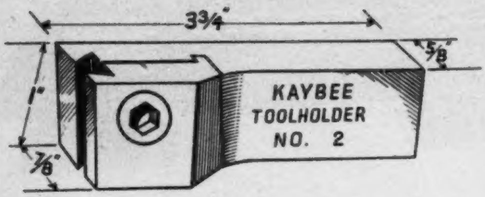
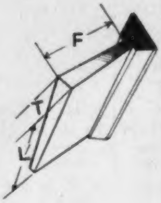
The "KAYBEE"

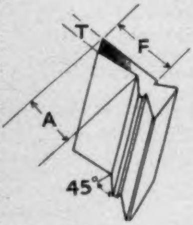
TANGENTIAL PARTING TOOL AND HOLDER



PARTING OFF
TOOL DIMENSIONS

TOOL No.	F	T	L
48	9/16"	1/8"	1 5/8"
68	13/16"	5/32"	1 3/4"
88	1 1/16"	3/16"	1 3/4"



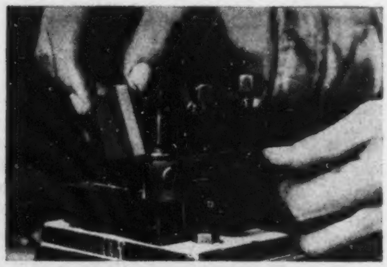


PARTING OFF & CHAMFERING
TOOL DIMENSIONS

TOOL No.	F	T	L	A
24	11/16"	1/8"	1 5/8"	3/8"
34	13/16"	1/8"	1 3/4"	1/2"
44	1 1/16"	5/32"	1 3/4"	3/4"

- ✱ ***ROBUST . . . EASY TO SET***
- ✱ ***MINIMUM OVERHANG FOR MAXIMUM RIGIDITY***
- ✱ ***REGRINDING REQUIRED ON ONE FACE ONLY***
- ✱ ***TOOLS MADE FROM 20% TUNGSTEN, 10% COBALT STEEL***

- ■ Standard clearance angles throughout length of blade.
- ■ Reducing regrinding to top rake only, without disturbing setting.
- ■ Length of blade ensures maximum number of regrinds.
- ■ Minimum overhang from tool post gives exceptional rigidity to blade.
- ■ No packing required to attain centre height.
- ■ Blade may be positioned to within .275 of collet face.
- ■ Overloading forces tool down and away from cut, minimising breakages.



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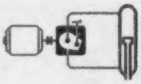

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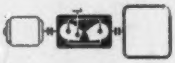
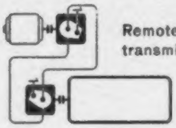
Hydraulic
transmission gears
and high-pressure pumps
from 2 HP
to several hundred HP



Standard
transmission gears



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Regulation with
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High efficiency over a wide range

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Rapid, joltless reversing

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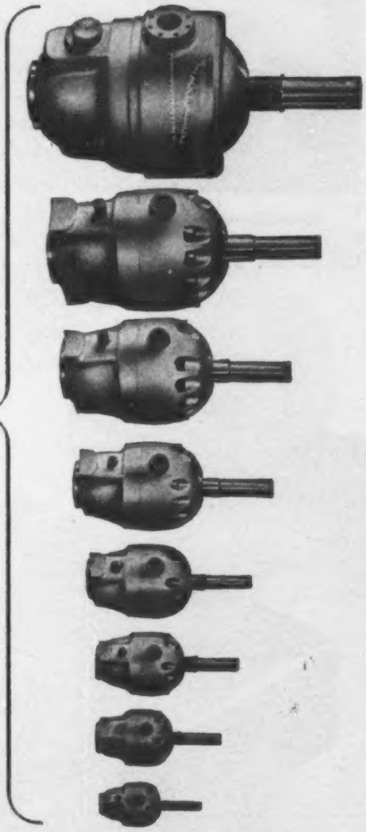

HYDRO TITAN Units

HYDRO TITAN

the economical, proved and reliable
transmission gear
for all branches of industry and transport

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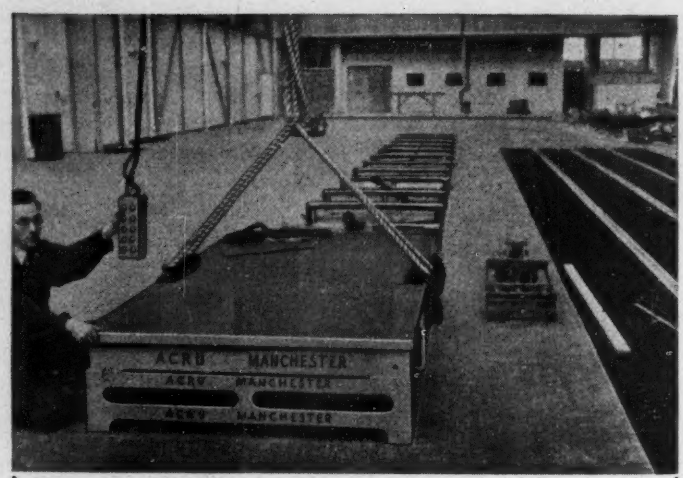


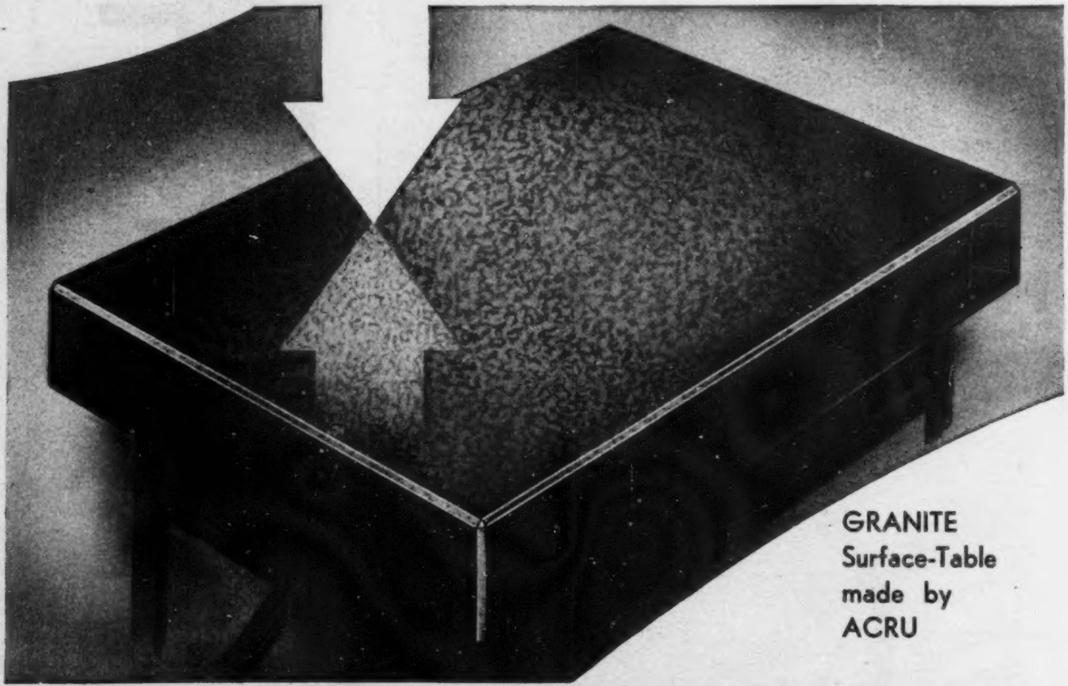
Assembly of the 70 ft. long Surface Table to accuracy of 0·002 in. over the whole length.

The largest SURFACE TABLE ever made in this country (70ft. long) has been supplied to the new Ship-Hydrodynamics Laboratory at Feltham by

'ACRU'

Acru Surface Plates and Tables Camel Back Straightedges, Angle Plates, etc., etc., are not only accurate to B.S.S. limits when delivered, but keep their accuracy permanently, because we are the largest stockholders of well-seasoned castings in the country. NO plate, Table, Straightedge, Angle Plate, etc., is put to the finishing operation until 12 months have elapsed since the first machining.

THE ACRU SURFACE
with the long lasting accuracy



GRANITE
Surface-Table
made by
ACRU

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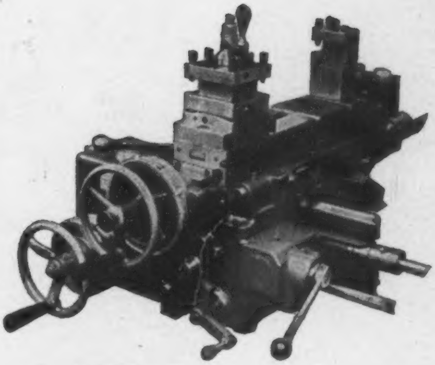
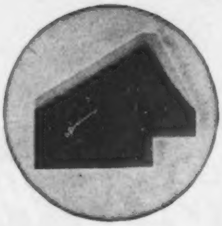
No. 5 SENIOR PREOPTIVE CAPSTAN LATHE *for chuck work up to 15½" swing or bar work up to 2½" diameter*



Preoptive Headstock eliminates idle time due to speed changing. Speeds pre - selected and engaged without stopping spindle.

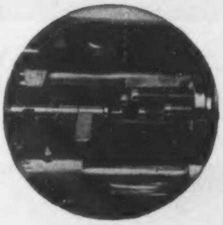
Forged-steel cross slide. Quick-acting, self-indexing square turret.

Single lever operates longitudinal and transverse feeds to the saddle which are reversible independently of those to the capstan slide.



Longitudinal feed motion accurately controlled by barrel-type trip and dead stops.

Single-shot lubrication to all enclosed mating surfaces of capstan slide and turret.

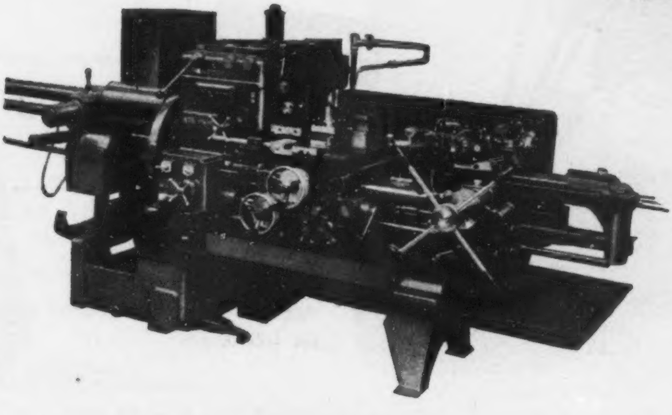


Turret is automatically clamped. Hollow construction permits bars to be passed through when required.

Single lever disengages automatic indexing mechanism and enables turret to be rotated by hand when required.

Flamard-treated bedways and other wearing surfaces practically eliminate wear and ensure maintenance of original accuracy.

Available for Early Delivery



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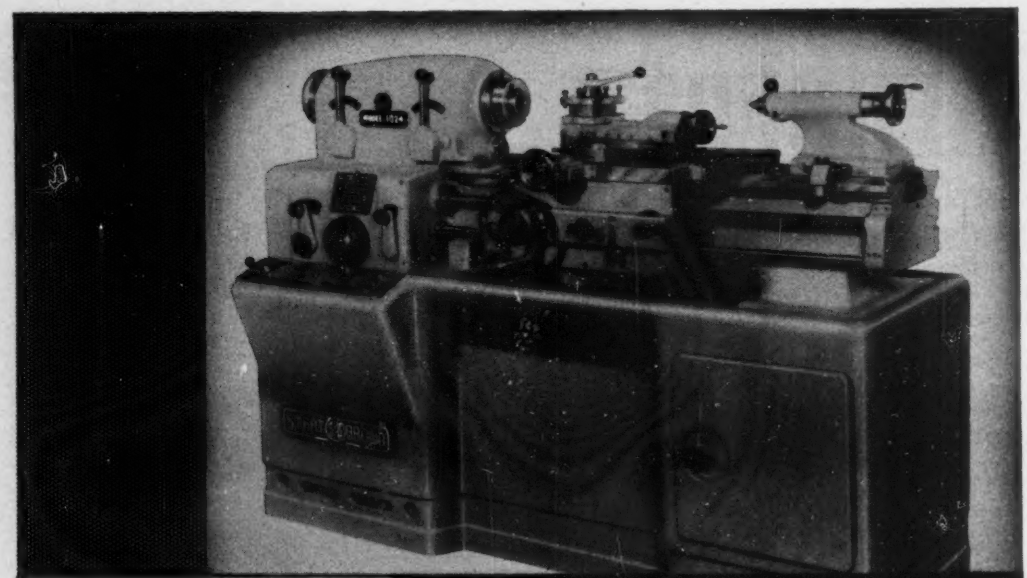
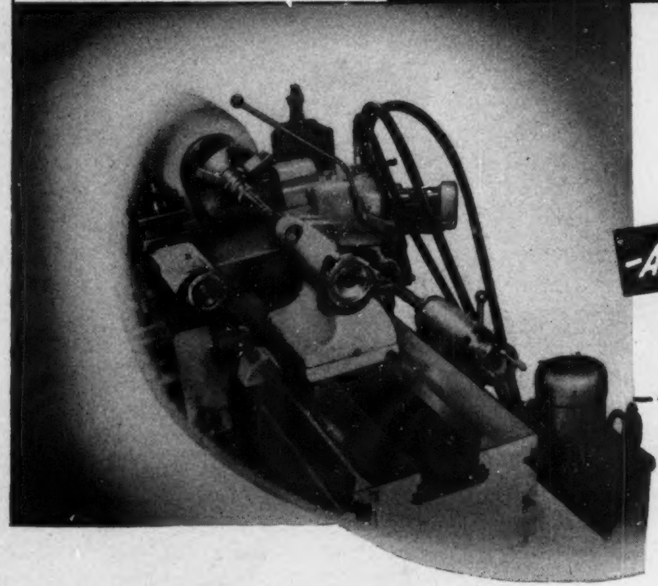


the 1024 *Precision Toolroom Lathe*



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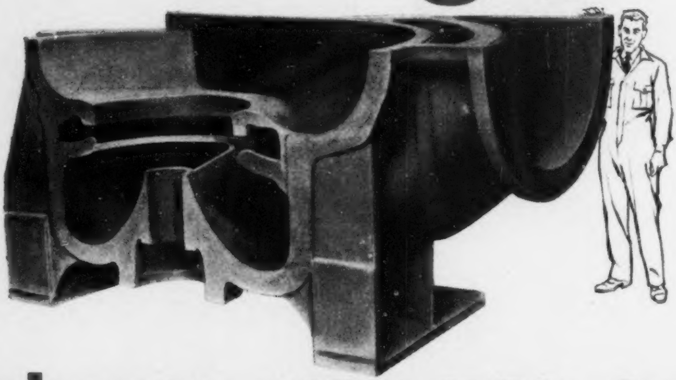
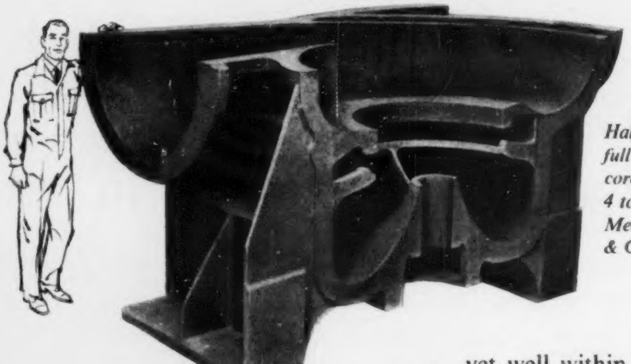


whichever way you cast it



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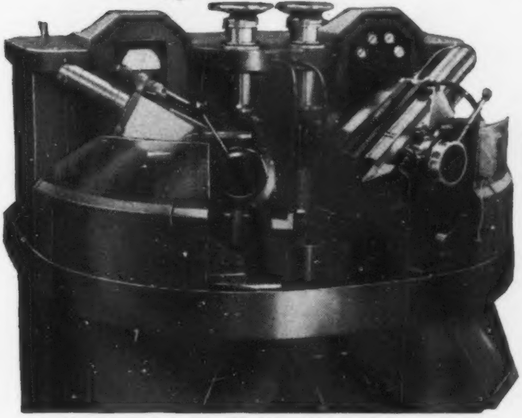

For many production jobs it is a distinct advantage to have your work piece vertically mounted on a vertical spindle lathe. This machine is simple to set up and load and extremely rigid.

The VERTIMAX Vertical Spindle Production Lathe represents the best in this type of machine. Its features include an air-operated chuck and spindle brake, two independent and adjustable tool slides, which can be swung through any angle, infinitely variable hydraulic feed, automatic operation, grouped controls, and it takes the *minimum of floor space.*

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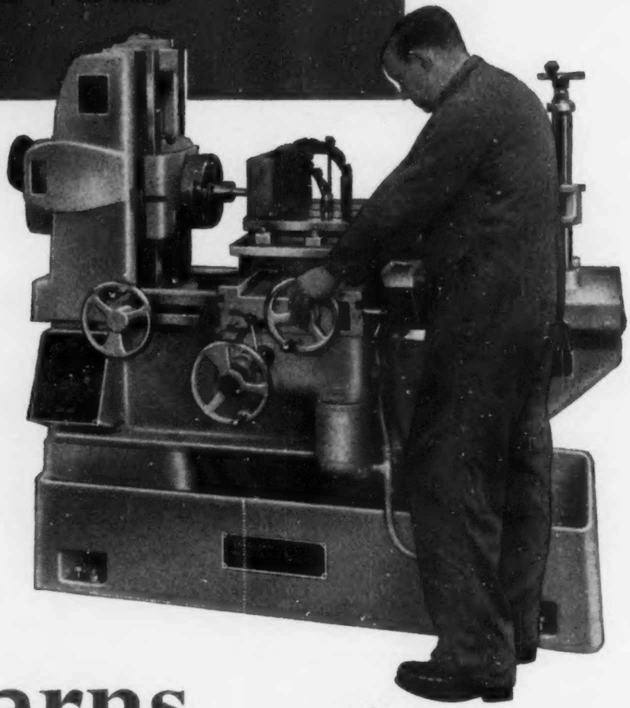

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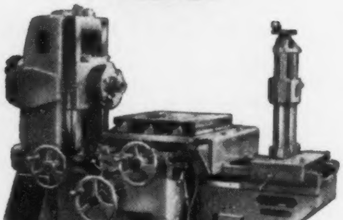
—almost a workshop in itself



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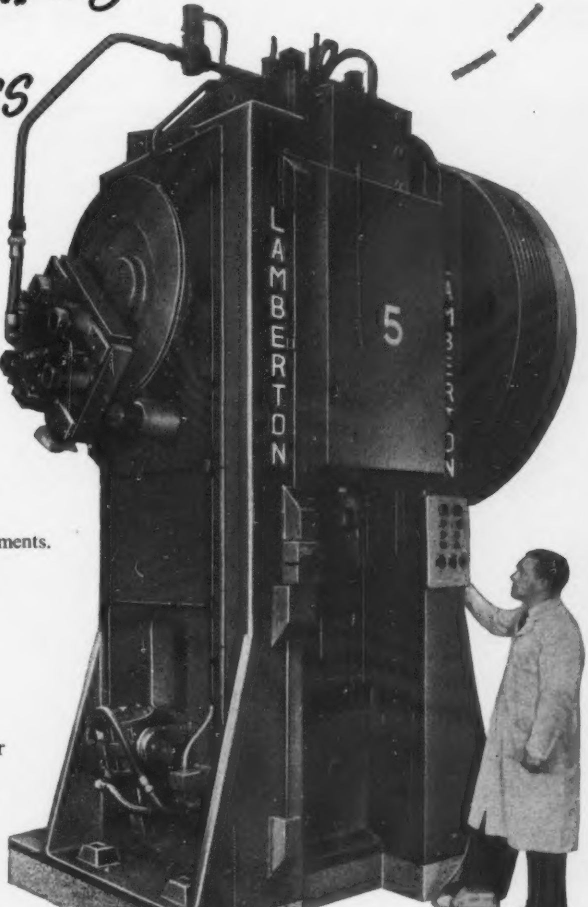

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Our own design giving excellent performance under severest conditions.

Top and bottom ejectors
air operated, adjustable to suit all requirements.

Operation of air ejectors
can be limited to every second or third stroke as required.

Calibrated table adjustment
ensures accurate die setting.

The Lamberton Press produces accurate forgings at high speed under rigorous production conditions, and requires minimum maintenance for safe, reliable operation.

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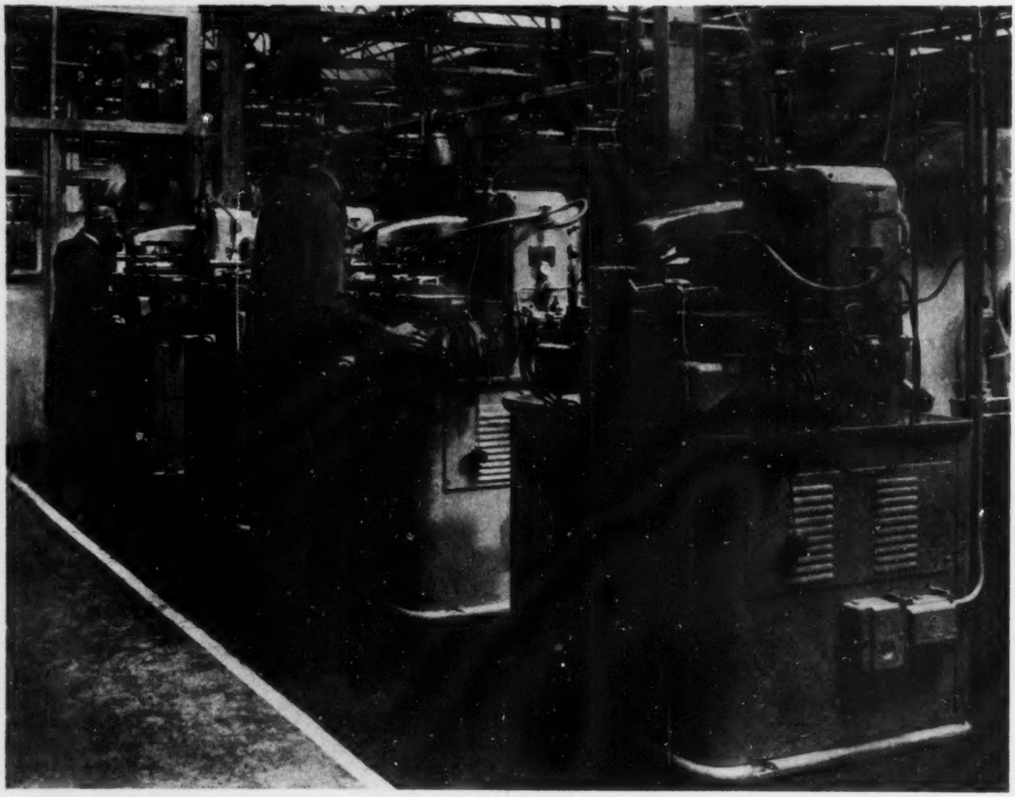
for consecutive operations in automatic sequence are used by ROLLS ROYCE at their aero-engine factory at Derby.



Four of a batch of eight machines, each operator works two machines.

Photograph by courtesy of Rolls Royce Ltd., Derby

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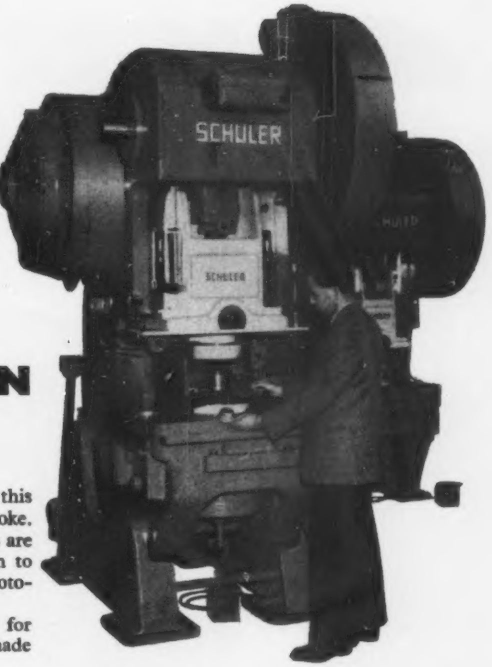

C-FRAME PRESS for SAFETY and AUTOMATION

from 63 tons pressure

The electro-magnetically operated robust friction clutch on this Press can stop the Press simply and safely in any position of stroke. Top stopping and button instant stop action cut out positions are dial set. The clutch circuit is ideally suited for connection to guards, safety switches in tools, and contact switch, photo-electric and other control devices.

It is said that two-thirds of Press cycle time is required for ejection. With this Press part of the downstroke can be made use of for ejection merely by turning a dial.

The absence of pneumatics means quicker response.

The press guard can be arranged to be fully operative during tool setting.

We claim that the clutch and brake on this Press are so reliable that the machine can be employed safely with a photo-electric guard—as illustrated.

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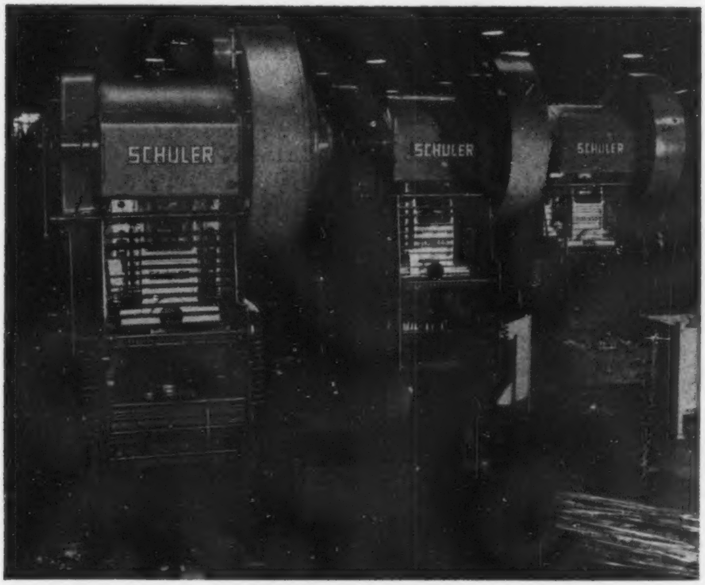

**Schuler C-Frame Presses.
3 of one and a half dozen Schuler
Machines installed at
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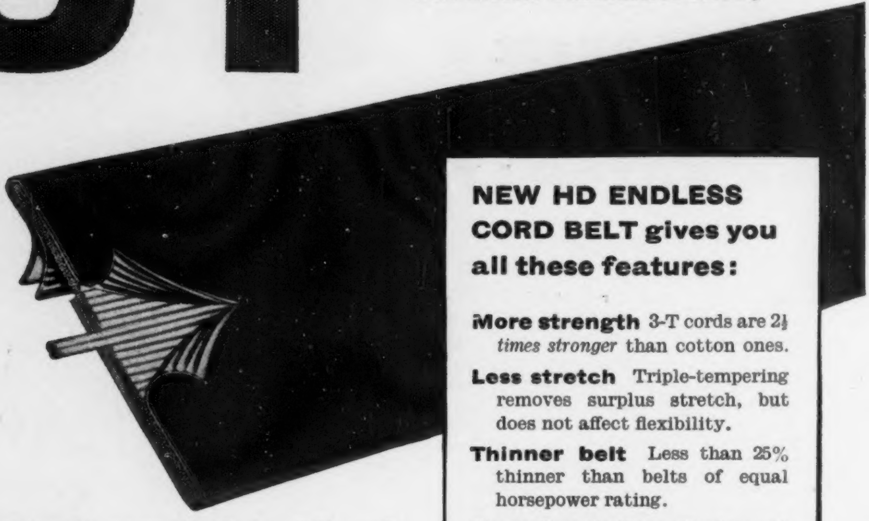
3T CORD Exclusive Goodyear development means stronger, thinner, more flexible transmission belting



NEW HD ENDLESS CORD BELT gives you all these features:

More strength 3-T cords are 2½ *times stronger* than cotton ones.

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Thinner belt Less than 25% thinner than belts of equal horsepower rating.

No splice failure Cord wound continuously around two pulleys in construction to give truly endless belt.

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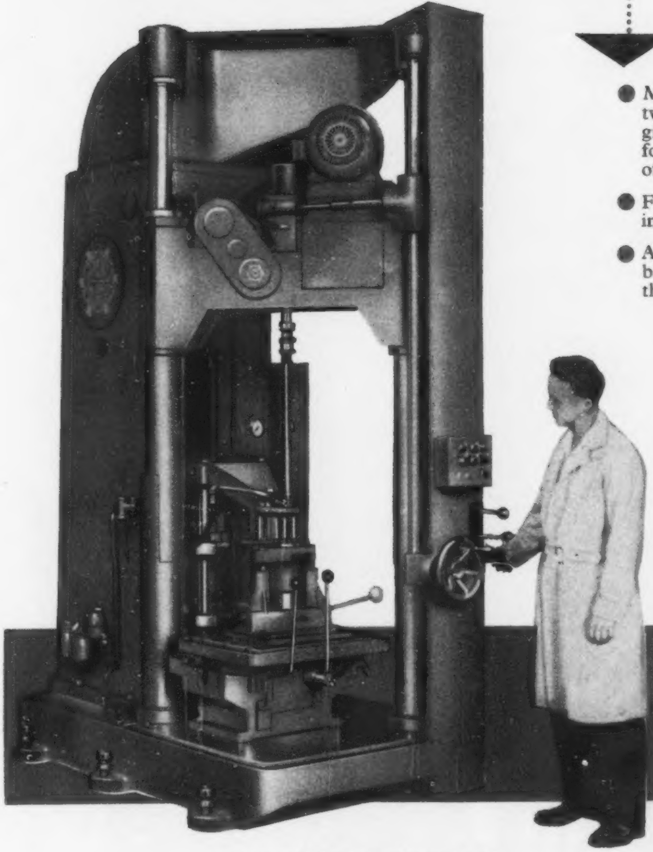
UNIVERSAL HONING MACHINE

JONES SHIPMAN

model 425 hydrohoner



- Moving head operated by twin hydraulic cylinders giving 32in. maximum stroke for overall height of machine of 140in.
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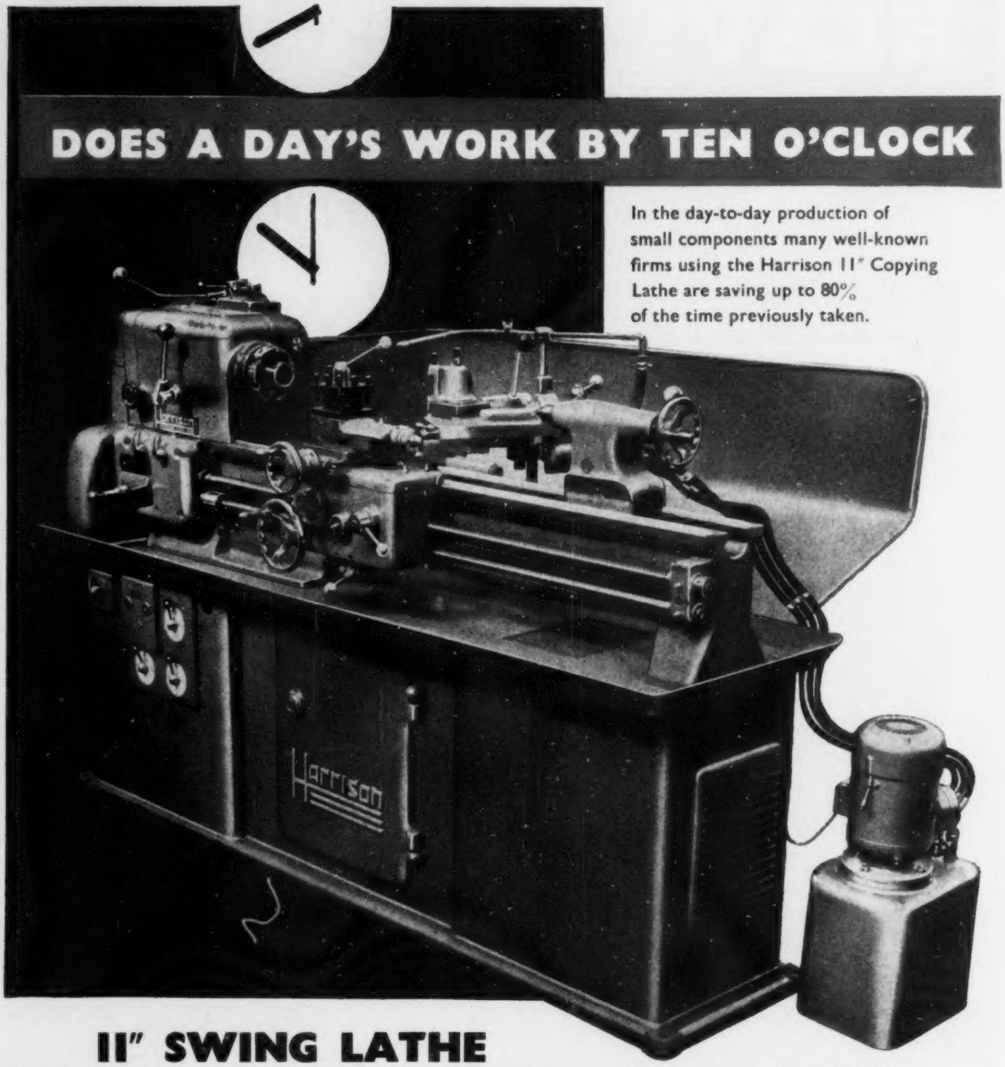

In the day-to-day production of small components many well-known firms using the Harrison 11" Copying Lathe are saving up to 80% of the time previously taken.

11" SWING LATHE

WITH INBUILT COPYING EQUIPMENT

Where large quantities are needed we shall be pleased to submit estimated times if you will send us your drawings and specifications of material to be machined.

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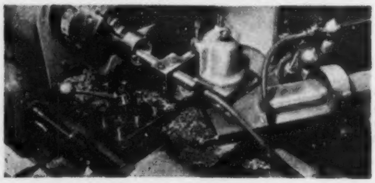

Copy boring with the Harrison 11" Copying Lathe

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PRODUCT OF THE Morrisflex GROUP OF COMPANIES

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You can rough and finish both gears and pinions on either the new No. 108 or No. 118 Hypoid Generator and four cutting methods are available to meet your production requirements.

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For full production—three methods.

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Non-generated ring gears are both roughed and finished from the solid blank in one Cyclex operation. This is the fastest method available for producing good quality spiral bevel and hypoid gears.

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Non-generated gears are first roughed out; then on the *same* machine one cutting revolution of the Single-Cycle cutter finishes each tooth. This method assures even distribution of cutter chip load and exact repetition of tooth shape with the finest surface finish. This method is four to five times faster than finishing by generation.

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In separate roughing and finishing operations you can rough out and complete spiral bevel and hypoid gears. In using this method both the gear and pinion are generated and a wide range of work can be accommodated.

Such versatility alone can reduce the unit cost of your gear and pinion production. Add to this the low initial investment of the machines themselves and you've found new economy in gear manufacturing.

Spiral bevel and hypoid gears up to 8½in. in diameter and up to 4 D.P. are accommodated on the No. 108 and up to 15in. diameter and 2 D.P. on the No. 118 Hypoid Generator.

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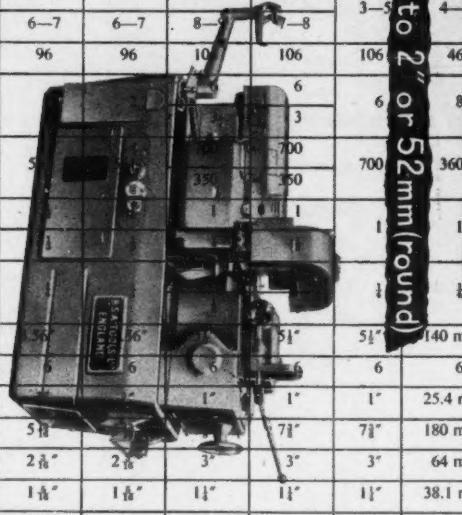
on TWELVE BASIC TYPES

capacities up to 2" or 52mm(round)

MACHINE		48	68	18L	25L	68L	88L	98L	138L	168L	METRIC 24	METRIC 36	METRIC 52
Workspindle capacity	round	½"	¾"	18 mm.	25 mm.	⅝"	1"	1¼"	1⅝"	2"	24 mm.	36 mm.	52 mm.
	square	.353"	½"	13 mm.	18 mm.	.0530"	.0708"	[illegible]	1⅛"	1.414"	17 mm.	25.4 mm.	35 mm.
	hexagon	.437"	⅝"	16 mm.	22 mm.	0.650"	0.866"	[illegible]	1⅜"	1.730"	20 mm.	30 mm.	45 mm.
Max feed in one movement	long stroke	2"	3"	75 mm.	75 mm.	3"	3"	4"	4"	4"	90 mm.	90 mm.	90 mm.
	short stroke	1"	2"			2"		2½"	2½"				
Stroke of turret cam (standard)		1⅜"	2¼"	50 mm.	50 mm.	2¼"	2¼	3"	3"	3"	80 mm.	80 mm.	80 mm.
Max. diameter using diehead		⅜" fine	½" fine	16 mm.	16 mm.	⅝" fine	⅝" fine	1"	1¼"	1¼"	18 mm.	18 mm.	18 mm.
Range of spindle speeds		166—7,370	53—4,480	40—4,500	40—4,500	53—4,480	53—4,480	70—3490 24—3590	78—2300 25—2540	69—1,520	38—3,000	24—1,900	30—1,500
Number of high speeds	4 speed	18	10	14	14	10	10	22	19	17	10	10	8
	2 speed			14	14	10	10	13	12				
Low speeds available for each high speed		2	10	11—13	11—13	7—9	7—9	3—5	3—5	3—5	4—5	4—5	4—5
				9—10	9—10	6—7	6—7	[illegible]	7—8				
Number of cycle times		46	65	96	96	96	96	[illegible]	106	106	46	46	46
Cycle time range (secs) fastest	long strok	¾	2	2	2	[illegible]	[illegible]	[illegible]	6	6	8	8	8
	short strok	¾							3				
slowest	long strok	75	180	561	561	[illegible]	[illegible]	[illegible]	700	700	360	360	360
	short strok	56½						350	350				
Actual time to feed stock (secs)	long strok	⅓	⅓	⅛	⅛	[illegible]	[illegible]	1	1	1	1	1	1
	short strok	¼	¼			[illegible]	[illegible]	[illegible]	[illegible]				
Time to change speed (secs)	long strok	⅛	⅛	⅛	⅛	[illegible]	[illegible]	[illegible]	[illegible]	¼	¼	¼	¼
	short strok	⅛	⅛										
Diameter of turret		3⅞"	4 1/16"	116 mm.	116 mm.	[illegible]	[illegible]	[illegible]	5½"	5½"	140 mm.	140 mm.	140 mm.
Number of turret holes		6	6	6	6	6	6	6	6	6	6	6	6
Diameter of turret hole		⅝"	⅝"	19.05 mm.	19.05 mm.	[illegible]	[illegible]	1"	1"	1"	25.4 mm.	25.4 mm.	25.4 mm.
Distance chuck to turre	nax.	3⅞"	5⅜"	120 mm.	120 mm.	5 13/16	[illegible]	[illegible]	7⅜"	7⅜"	180 mm.	180 mm.	180 mm.
	min.	1 13/16"	2⅜"	49 mm.	49 mm.	2 3/16"	2 3/16	3"	3"	3"	64 mm.	64 mm.	64 mm.
Turret slide adjustment		3/16"	⅜"	21 mm.	21 mm.	1 5/16"	1 5/16"	1¼"	1¼"	1¼"	38.1 mm.	38.1 mm.	38.1 mm.
Spindle centre to top of cr slide		1"	1 5/16"	30 mm.	30 mm.	1 5/16"	1 5/16"	1 7/16"	1 7/16"	1 7/16"	36 mm.	36 mm.	36 mm.
Movement of cross slide		1"	1¼"	32 mm.	32 mm.	1¼"	1¼"	1⅜"	1⅜"	1⅜"	40 mm.	40 mm.	40 mm.



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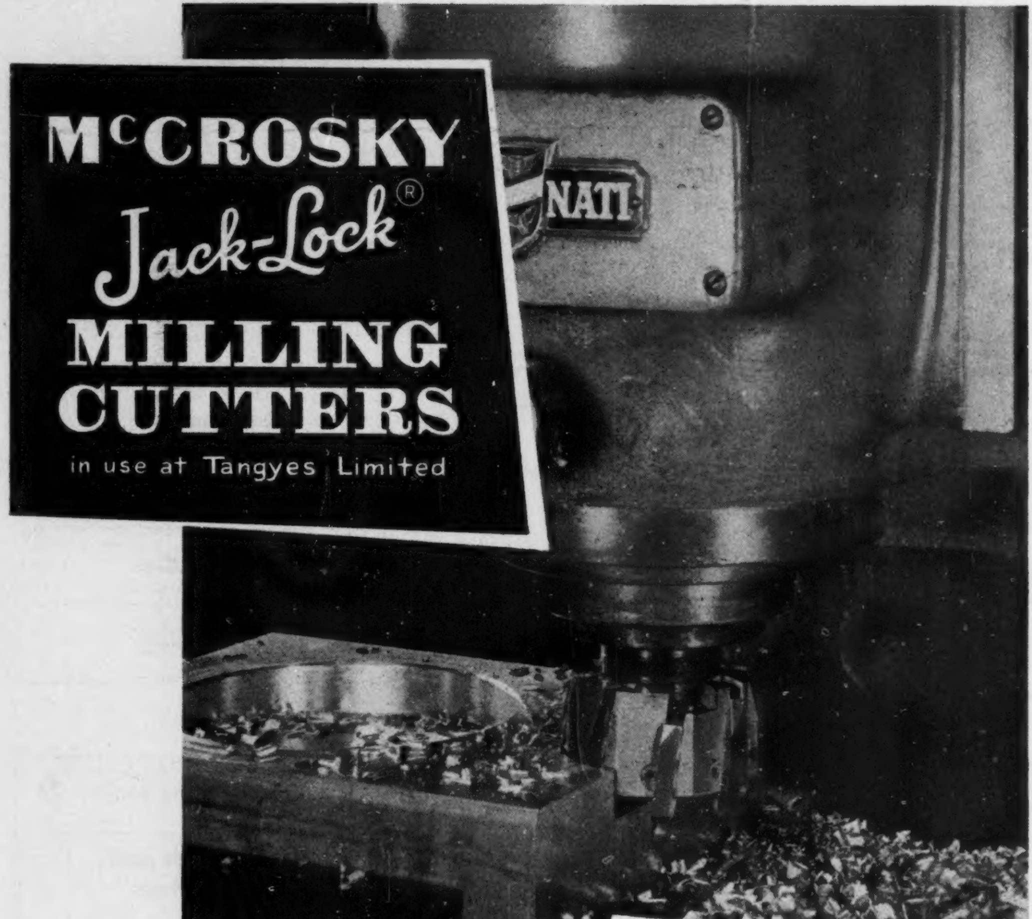

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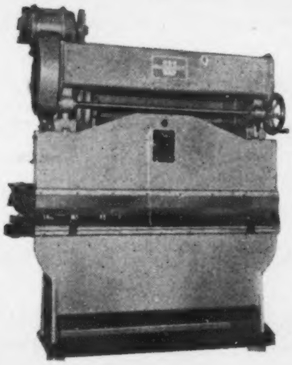

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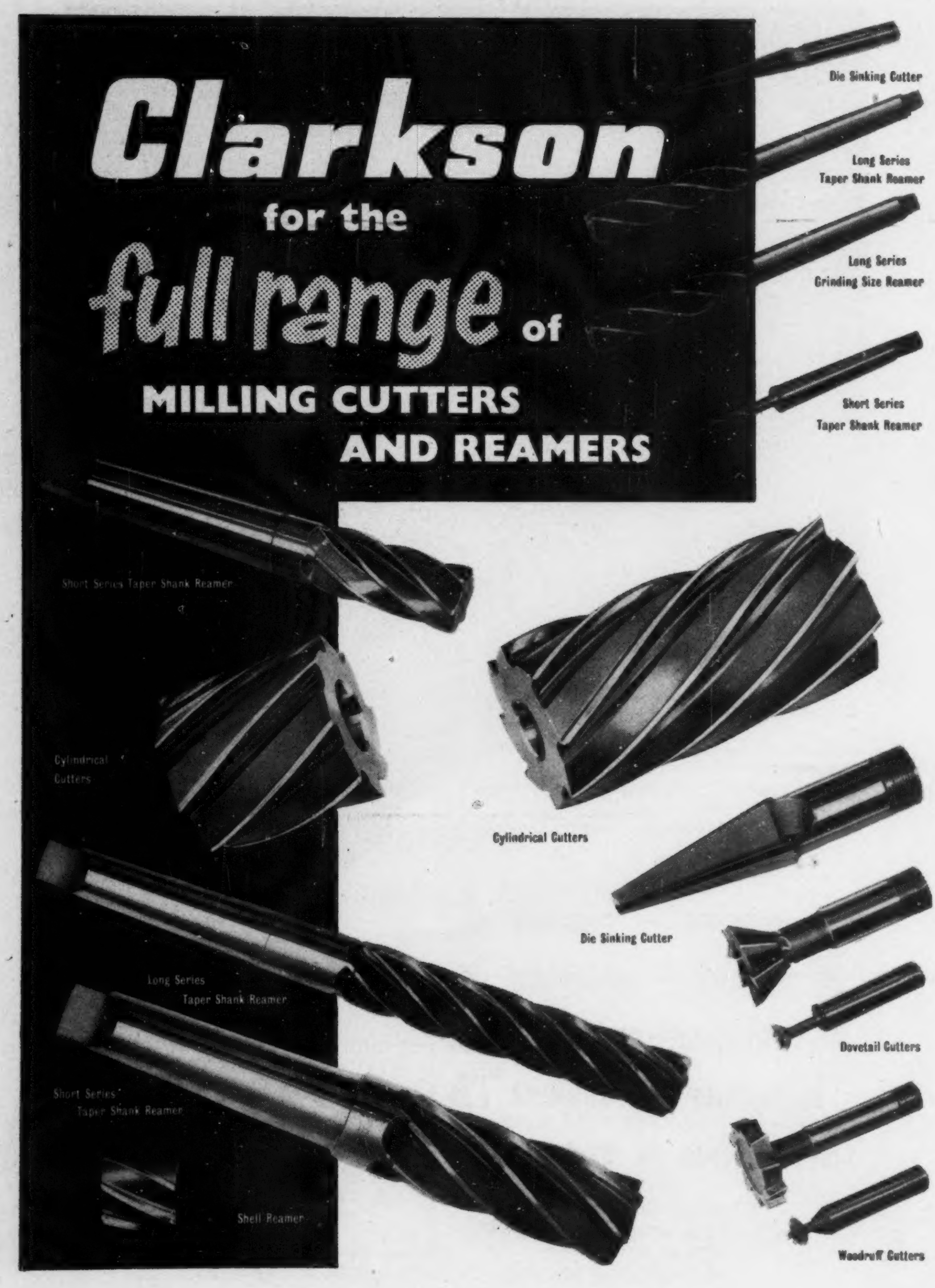
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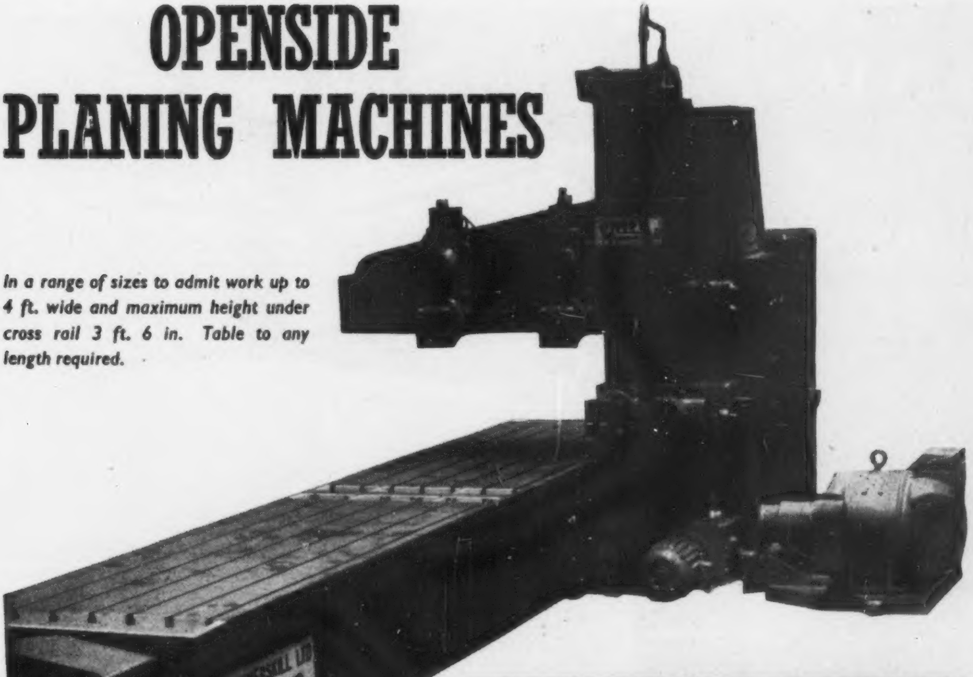
In a range of sizes to admit work up to 4 ft. wide and maximum height under cross rail 3 ft. 6 in. Table to any length required.



SWIFT
Summerskill

This view of a Swift-Summerskill Openside Planer shows clearly the robust proportions of the buttress for the cross rail, which ensures rigidity.

The Swift-Summerskill all electric openside planer is of modern design that ensures the utmost rigidity and accuracy of alignment. Single helical gearing is employed for the table drive and a standard range of speeds from 25 to 200 ft. per min. is available. If required, alternative ranges down to 10-80 f.p.m. can be provided. The two smaller machines have feeds of 0·005 in. to 0·350 in. and the two larger planers feeds of 0·005 in. to 0·450 in. Write today for a catalogue describing these and other Swift-Summerskill Planing Machines.

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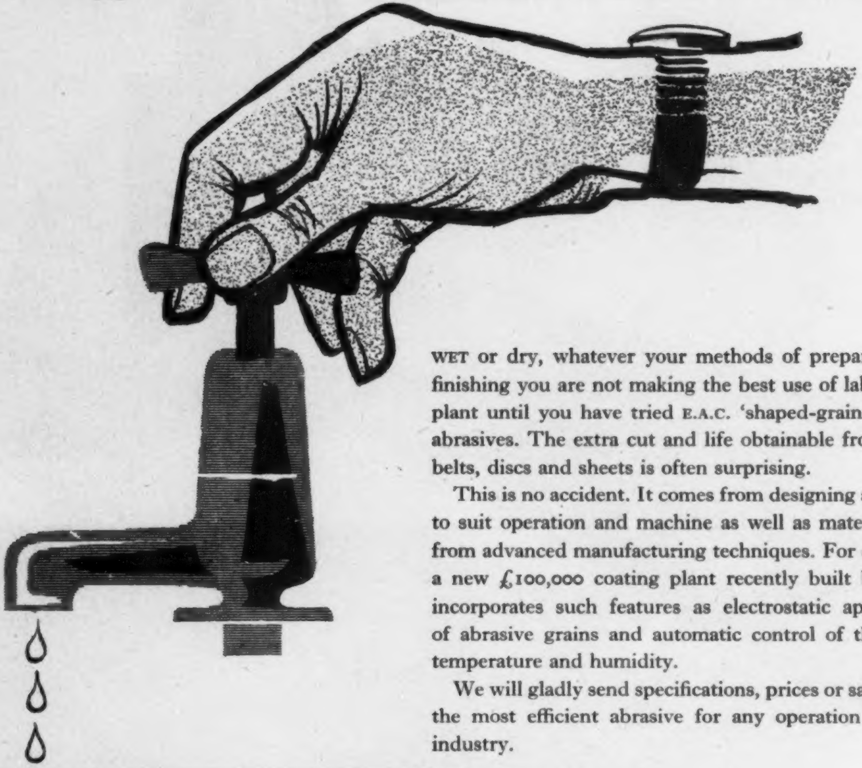

WET or dry, whatever your methods of preparation or finishing you are not making the best use of labour and plant until you have tried E.A.C. 'shaped-grain' flexible abrasives. The extra cut and life obtainable from E.A.C. belts, discs and sheets is often surprising.

This is no accident. It comes from designing abrasives to suit operation and machine as well as material; and from advanced manufacturing techniques. For example, a new £100,000 coating plant recently built by E.A.C. incorporates such features as electrostatic application of abrasive grains and automatic control of thickness, temperature and humidity.

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The popularity of this new rapid method of producing accurate surfaces is largely due to the introduction of E.A.C. electro-coated waterproof abrasives. Unlike dry band facing, the effectiveness of which is limited by heat generated, the modern wet belt is capable of extremely rapid, cool stock removal. It is suitable for flat and curved surfaces on all metals, plastics, glass, ceramics.

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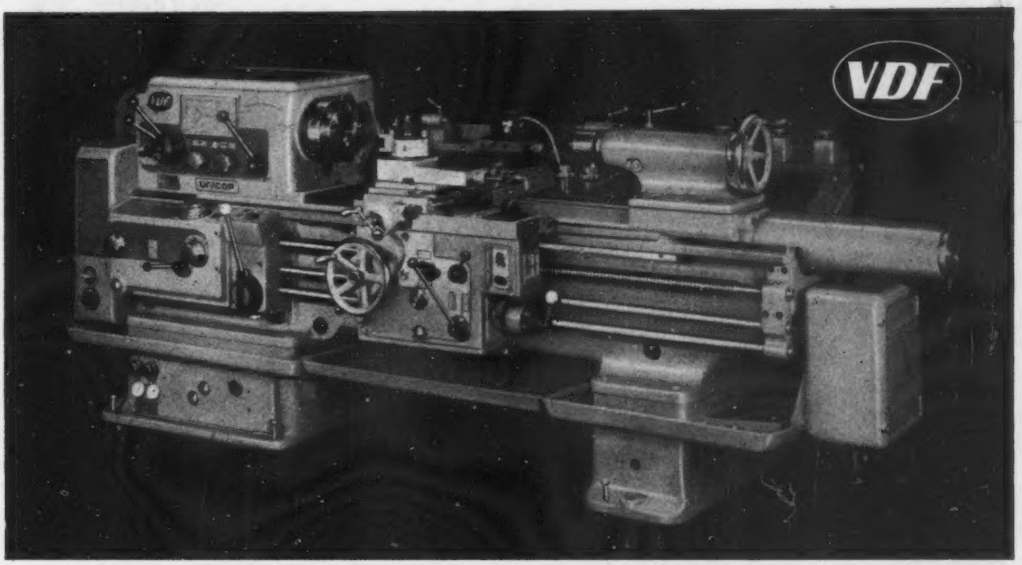

Ultra-Sensitive Multi-Purpose VDF Unicop I Copying Lathe

- So sensitive it can produce a sphere.
- Ideal for workshops where a single-purpose copying lathe would be uneconomical.
- For normal *and* copy turning.
- Suitable for longitudinal, external and internal copying and face copying.
- Electronic-hydraulic.
- Copying traverse up to 29½″ and cross copying to 5″. Increased if required.
- Can be delivered with high-speed headstock (top speed up to 5,600 r.p.m.).
- Also available Unicop III for production copying and Unicop V giving greater capacity for shaft work.

BRIEF SPECIFICATION
(3 models available)

■ swing over bed	20½″	20½″	26½″
■ centre distance (normal turning) up to	118″	118″	118″
■ max. copying length	39⅜″	39⅜″	39⅜″
■ height of centres	10″	10″	13″
■ main spindle bore	2⅛″	2⅛″	3″
■ no. of speeds	30	18	18
■ speeds r.p.m.	9–1800	22.4–1120 28 –1400 35.5–1800	11.2–560 14 –710 18 –900
■ motor h.p. up to max.	26	19	32

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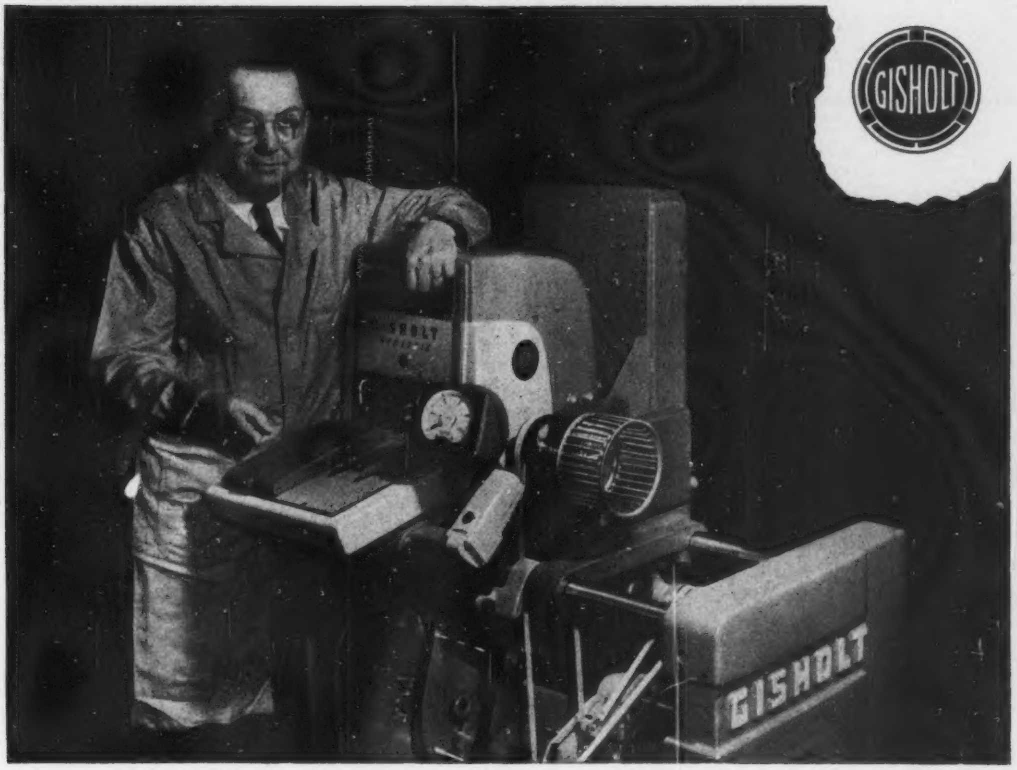

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don't stop at "good enough!"

Dynamic balancing has only one purpose—to eliminate vibration. Thus, it's a precision operation, worth doing *right*! Beware of these "good enough" standards.

Gisholt Balancing Machines enable you to set the highest possible standards and achieve them in minimum time. It's because they don't limit you in accuracy. Their extreme sensitivity enables you to measure vibratory movement of at least ·000025 inch. They locate and measure unbalance forces in a matter of seconds. They do it by separating—and isolating—unbalance effects in two different planes. They can provide readings directly in terms of correction units for your specific parts. These are very important in making your balancing operations more accurate and efficient.

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For high production dry cutting jobs on steels of all types use Norton B9 Resinoid Bonded Wheels. Their fast clean cutting abilities are enhanced by the added roughness of the sides—achieved by allowing the outside layers of abrasive grain to protrude naturally from the sides of the wheel giving more clearance in the cut. These are designated 'F' Sides. So, for the most economical dry cutting-off jobs with a really good finish specify Norton B9 Wheels with 'F' Sides.

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These new Norton Rubber Bonded Wheels have been developed for wet cutting operations. Extraordinary results have already been achieved on high-speed, alloy and other heat sensitive steels. Consider the possibilities of wet cutting with Norton R50 wheels if your jobs are being marred by excessive burring or burning.

Both these Norton Wheels are outstanding for their speed and quality of cut and for their long, economical performance. For the best advice on dry cutting with B9 Wheels or wet cutting with R50 wheels, consult your Norton or Alfred Herbert representative—or write to us

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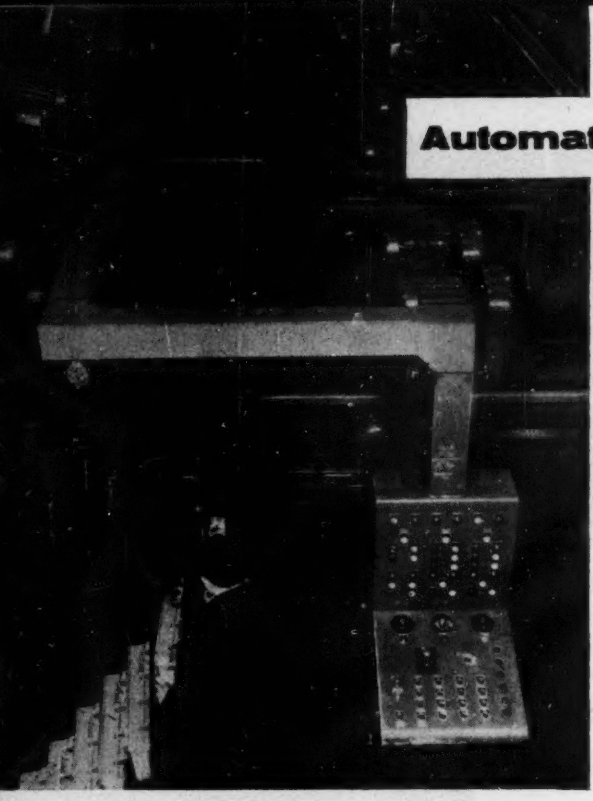

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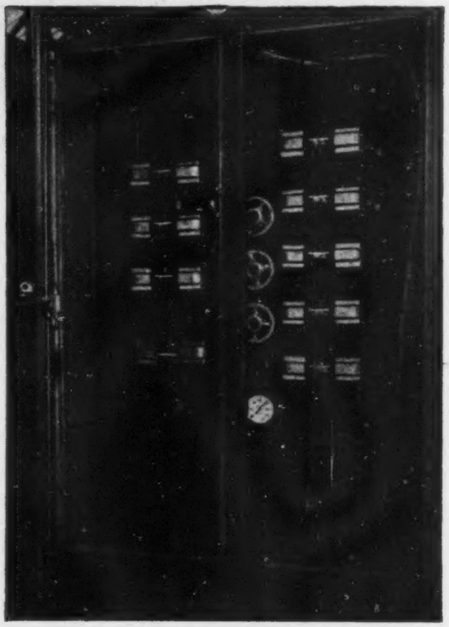
VICKERS-DETROIT Oil Hydraulics
for drilling, boring, reaming and
tapping operations
on 4 and 6 cylinder tractor heads.

View from the loading end of machine. Vickers-Detroit hydraulic units ensure perfect control of sequence operations, and uniform precision of components on leaving the machine.



View of a Vickers-Detroit control unit at the unload end.

For further details please write for publication 1/42

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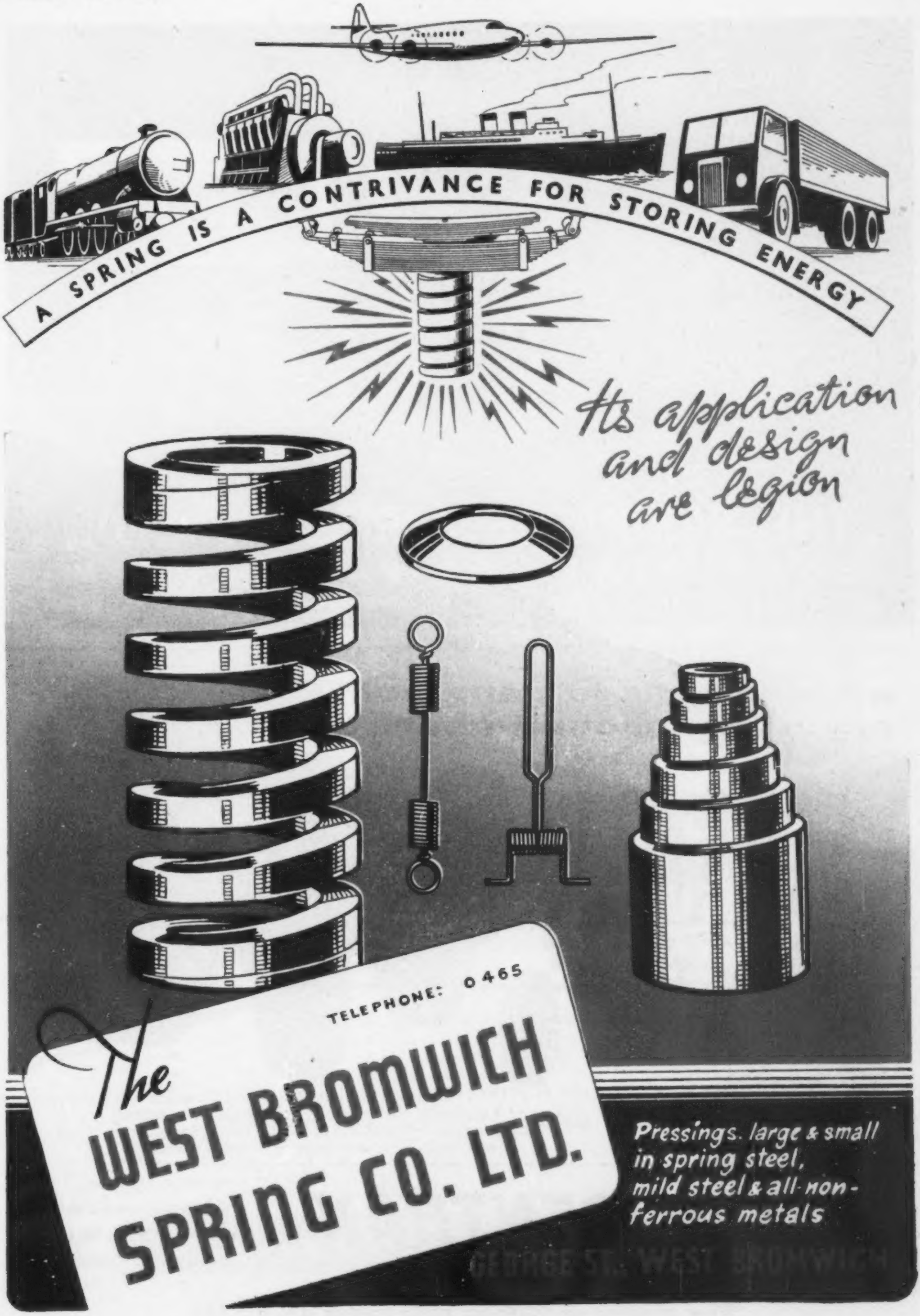
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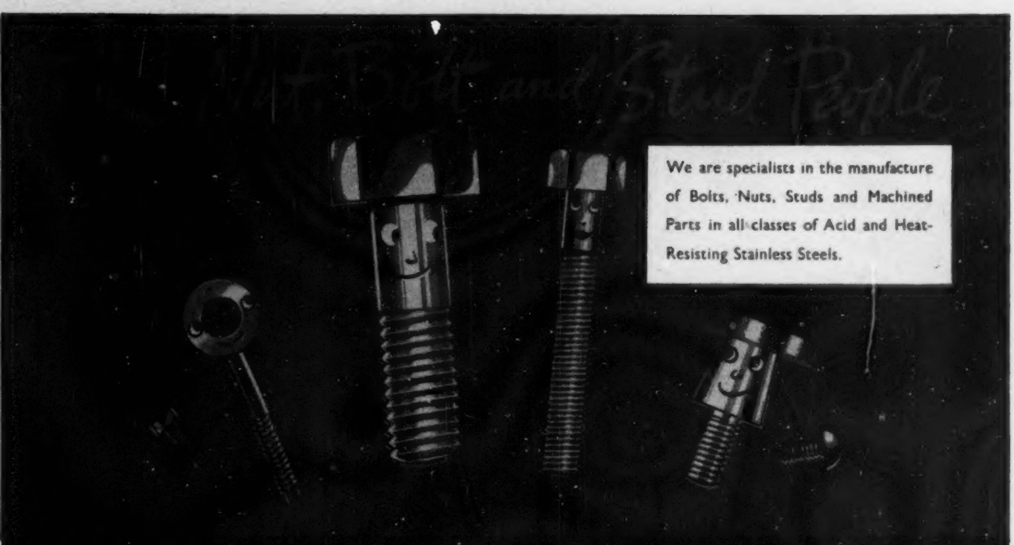

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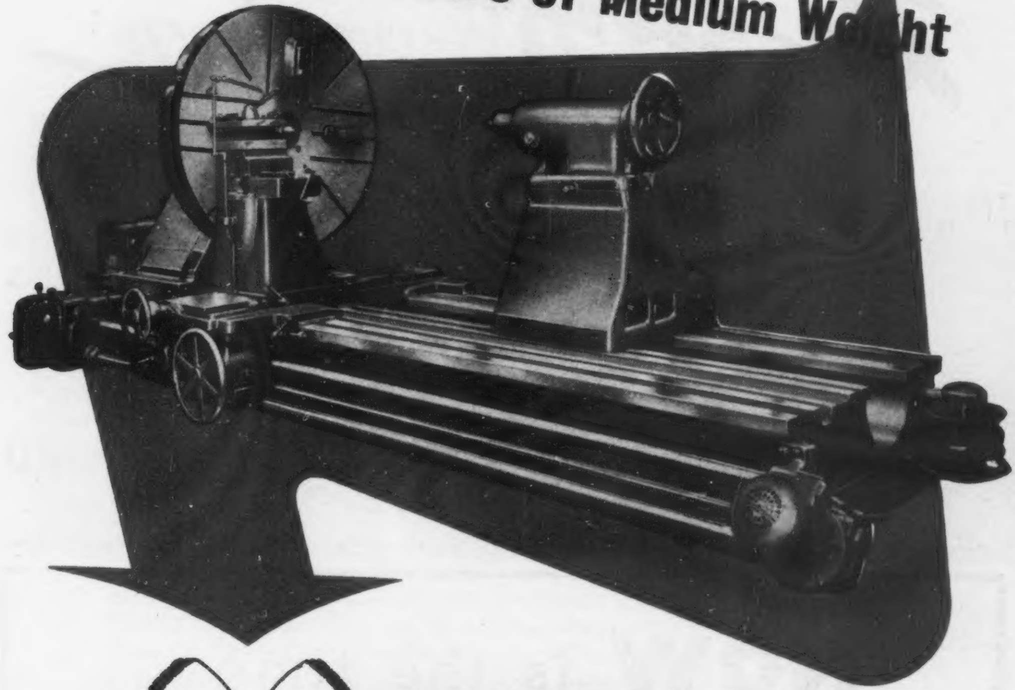

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Built with traditional **O & S** quality and workmanship and embodying the latest advancements in Drum Lathe design.

The O & S Drum Lathe incorporates all these features:

- Up to 6′ swing over saddle
- Up to 25′ between centres
- 12 spindle speeds
- Large hollow spindle
- Spindle bearings PB or Taper Roller
- 32 enclosed change feed and screw-cutting box
- Long lead cutting gear
- Quick power motion to saddle
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- 30 or 35 h.p. motor drive

The O & S Range also includes: SS & SC lathes from 10½ in. to 24 in. capacity; surfacing and boring lathes up to 96 in. swing; break lathes; axle lathes; railway carriage and wagon wheel lathes; axle journal turning and burnishing lathes; straightening presses.

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GRADE 'A' HAND SCRAPED AND SURFACED TO WITHIN 0·0001in.—0·0003in. FROM A MEAN TRUE PLANE OVER WHOLE SURFACE ACCORDING TO SIZE.

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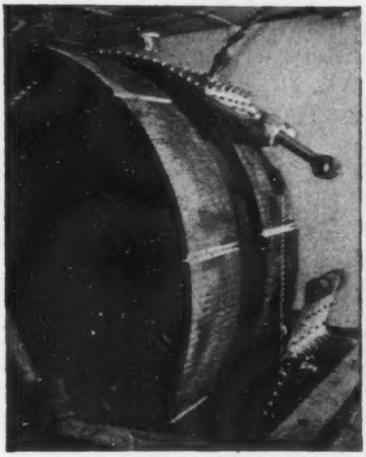

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*** Ferodo welcome *your* friction problems**

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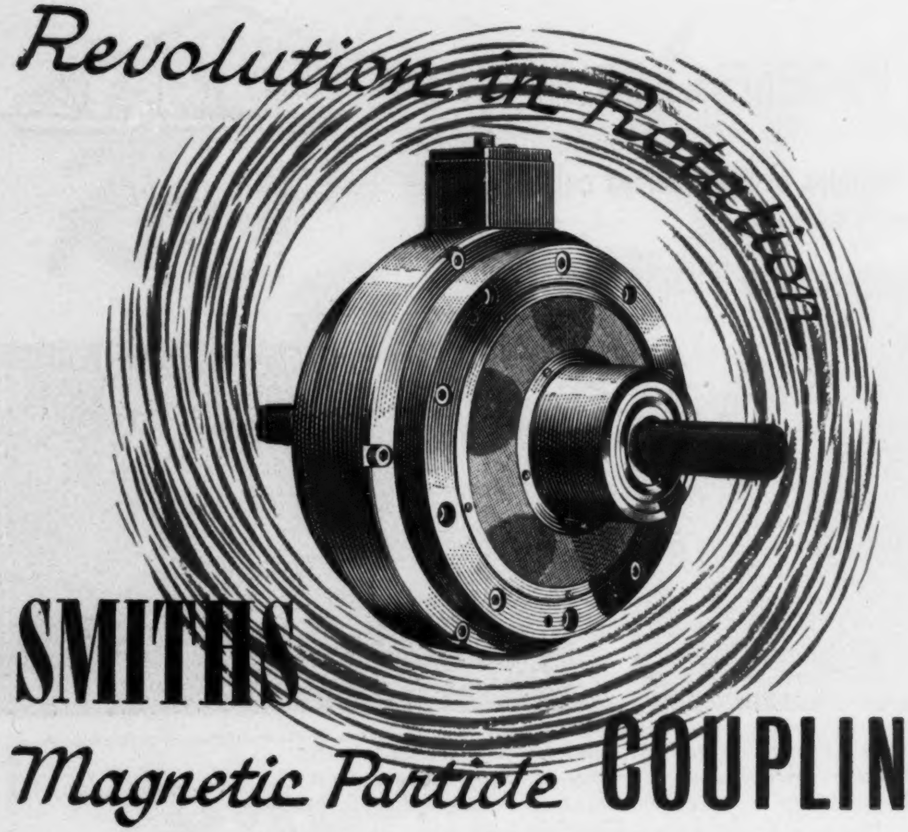

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Magnetic Particle COUPLING

which combines:—**the resilience of the hydraulic coupling and the positiveness of the frictional coupling.** It is revolutionary in that driving and driven elements are coupled by magnetically-activated particles. It has these advantages:—

- Accurate torque control
- No mechanical engagement and thus negligible wear
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- Acts as brake or coupling in **either** direction
- Perfectly smooth operation
- No slip rings—excitation coil is stationary
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- Dynamic and static coefficients of friction equal

The range comprises eight standard units with torque capacities from ½ to 200 lb/ft. SMITHS Magnetic Particle COUPLING is unique, its potentialities enormous. Let us advise you, therefore, how best to use it in your particular field.

SMITHS
S. SMITH & SONS (ENGLAND) LTD.
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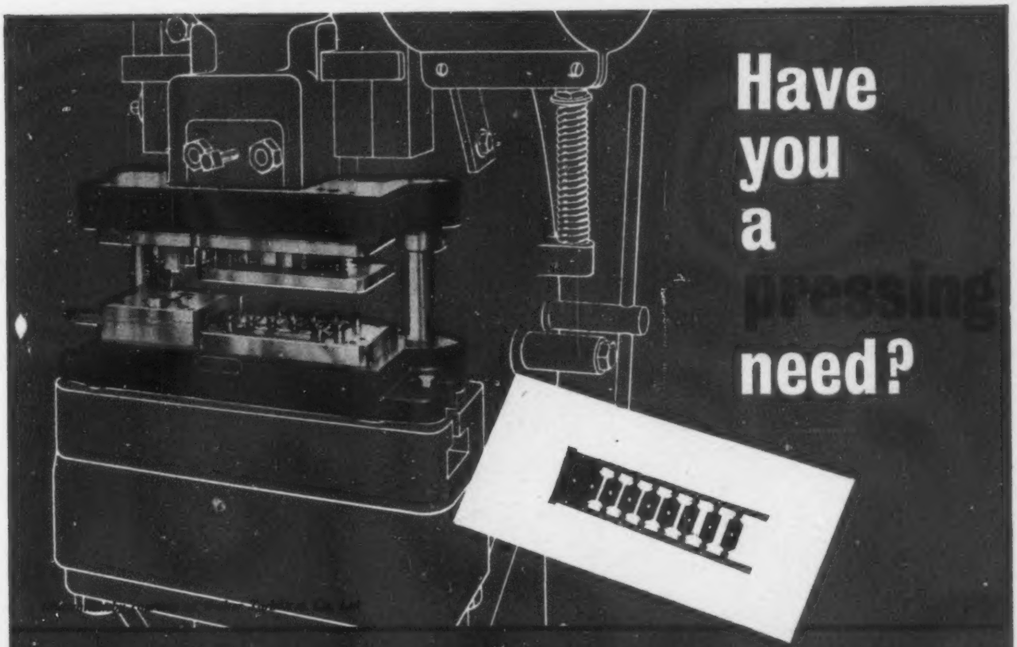

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K E 672 is an excellent general purpose oil hardening tool steel. When worked under normal conditions it is trouble free and ideal for a wide variety of blanking, pressing and piercing operations.

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Corrugated 'Perspex' gives better light for better work

LOOK AT THESE ADVANTAGES. Corrugated 'Perspex' has a very high light transmission and is immensely tough. It will withstand the severest weather, and is unharmed by the atmosphere of most industrial areas. At the same time it is very light, easy and economical to install. All over the country installations more than 10 years old are still giving satisfactory service.

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Expensive machine tools deserve a machine vice of equal precision—a role befitting the precision built DOWN-GRIP vice. Laborious setting-up time is substantially reduced. The quick action jaw slides right up to the job—a slight turn of the screw then gives instant and positive downward grip!

This vice has its own hardened and ground steel table, parallel to the base, providing a permanent foundation for precision work.

By simply pressing the thumb-triggers the movable jaw is entirely free to slide, thereby eliminating time wasted adjusting the normal machine vice.

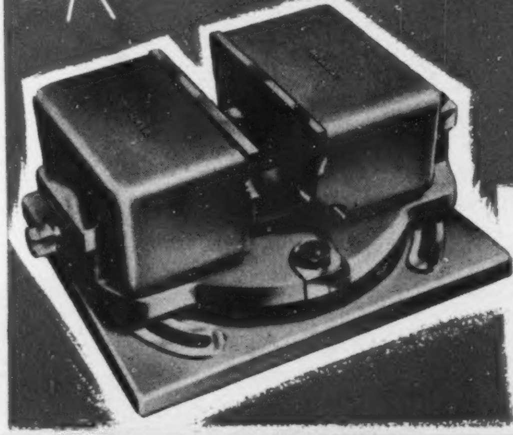
Hardened steel jaws are fitted as standard but soft jaws are available.

Vice swivels on base through 360°.

Reversible jaw plates for irregular shapes.

Standard range includes 4", 6" and 8" jaw widths.

THE DORMER DOWN GRIP



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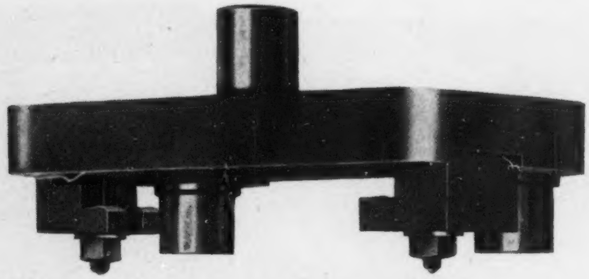
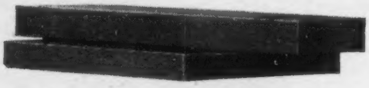
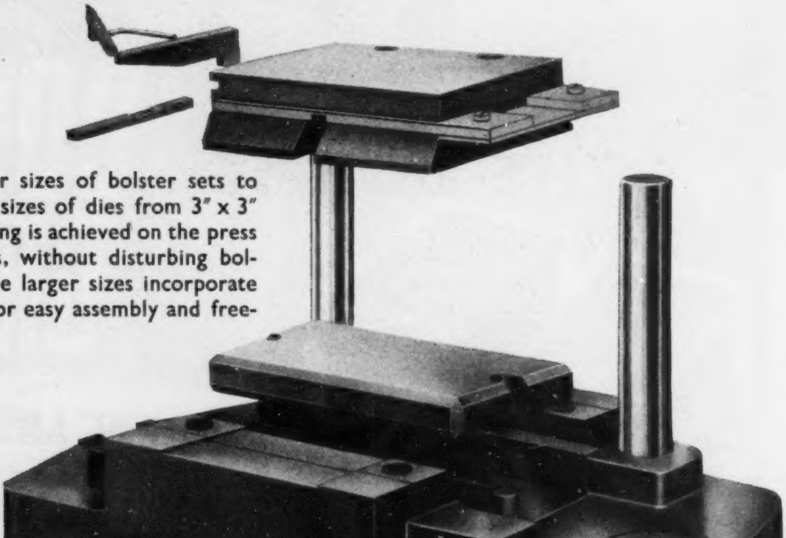


interchangeable TOOL SET



Bigger range and new features



Now available in four sizes of bolster sets to accommodate twelve sizes of dies from 3″ x 3″ to 7″ x 9″. Tool changing is achieved on the press within seven minutes, without disturbing bolsters. Bolsters on the larger sizes incorporate ball-bearing bushes, for easy assembly and freedom from jamming.

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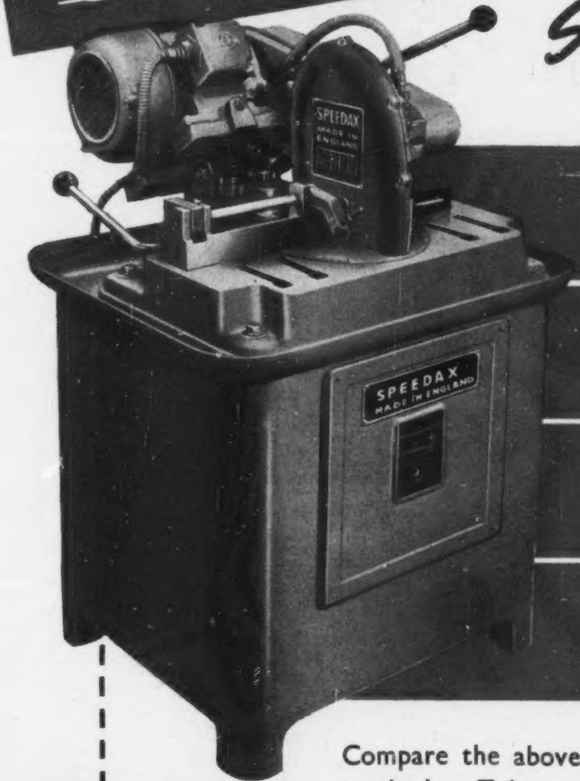
See these Savings!



1" DIA. STEEL BAR 5 SECS.

2" STEEL TUBE 4 SECS.

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1" × 1" BRASS BAR 6 SECS.

Compare the above cutting times with your present method. Tubes, angles, special sections, square, hexagon, or round bars, in steel, non-ferrous or plastic materials, can be cut at 90° or mitred in a fraction of the time taken by any other method.

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Floor type Model "B"
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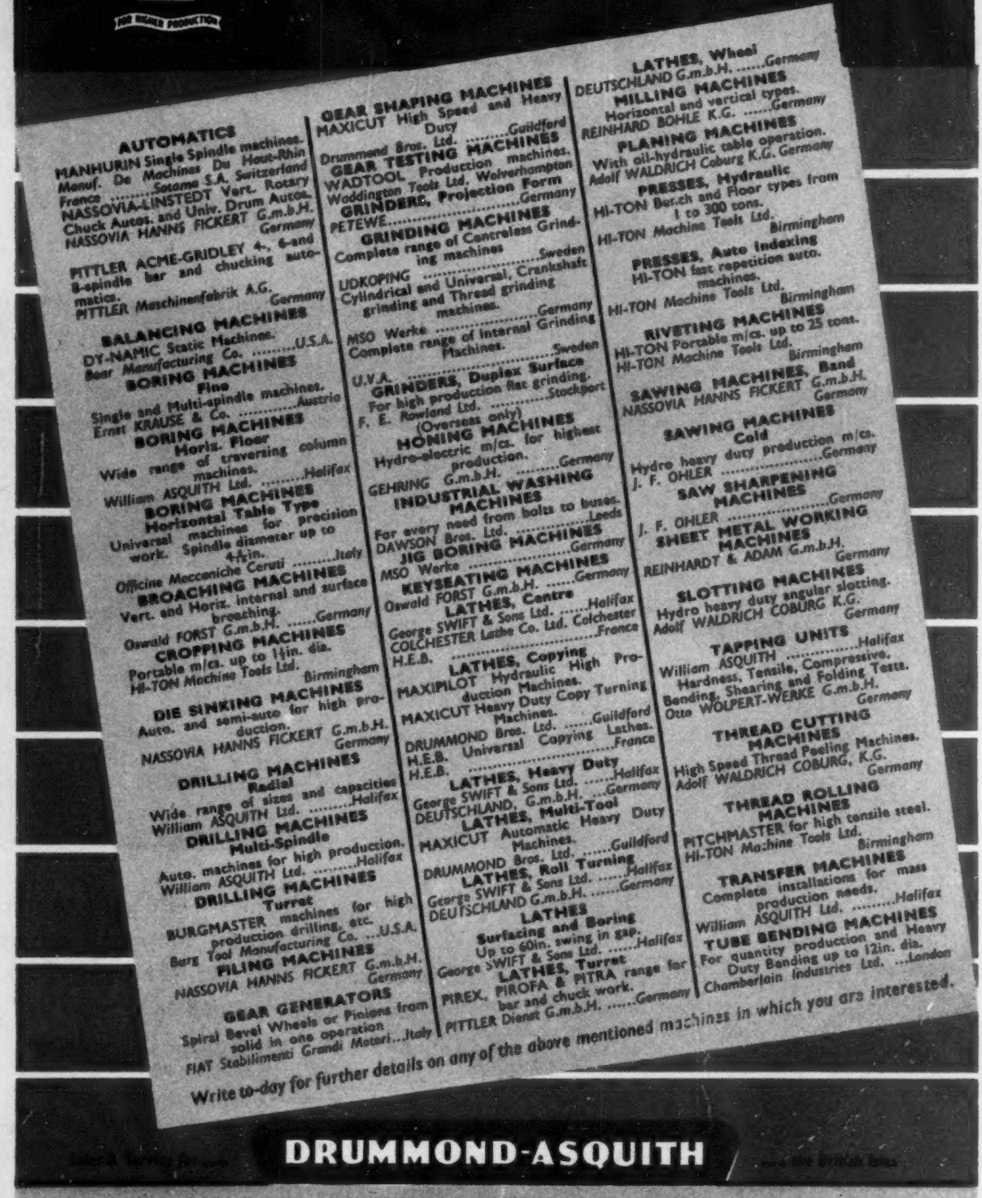

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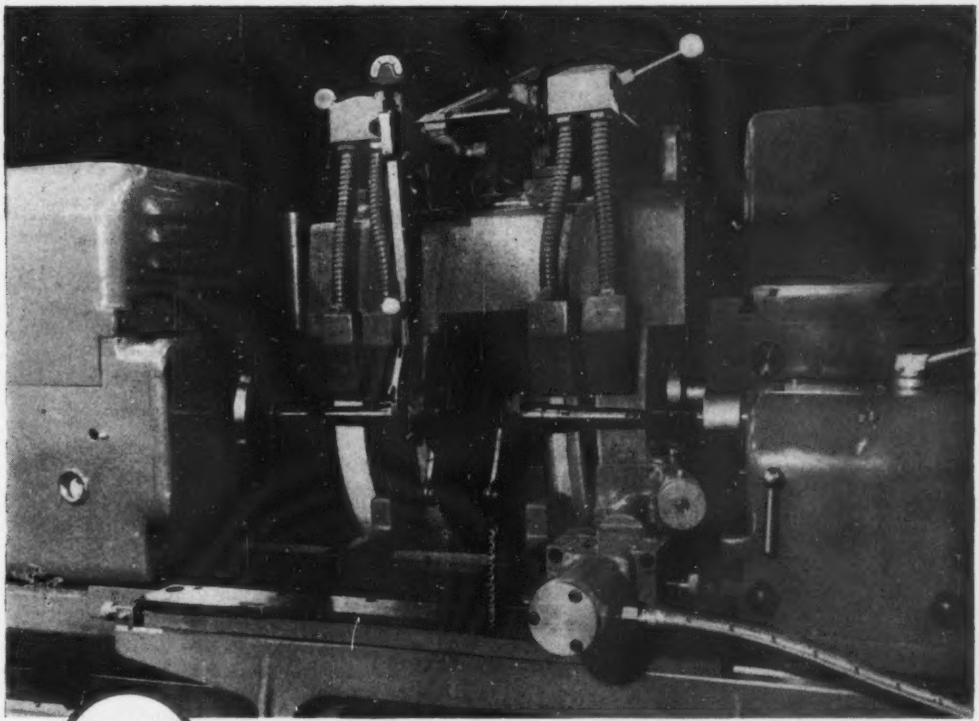

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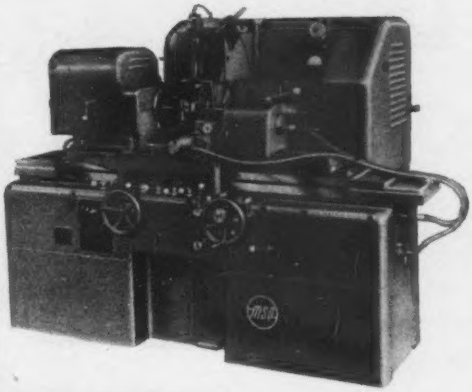

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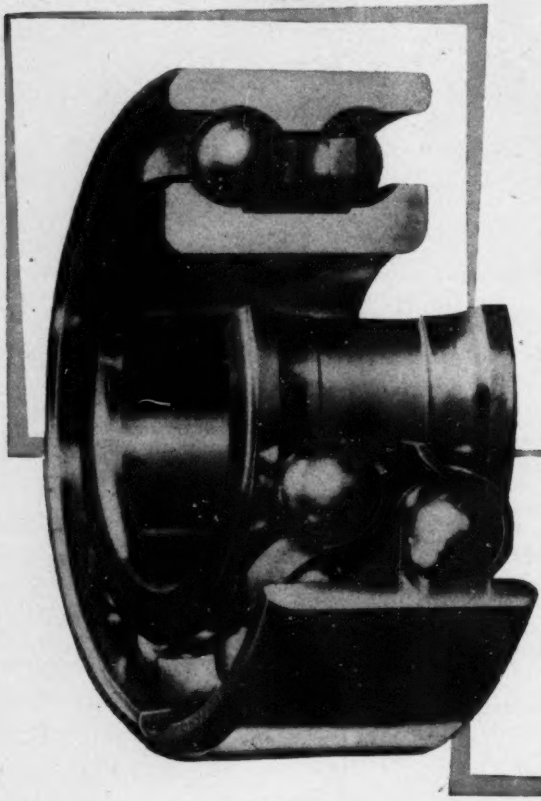

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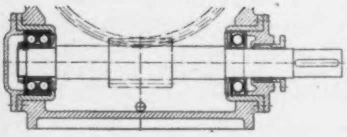

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Abstracts of Principal Articles

Aspects of Russian Engineering Industry P. 864

In this article, the eighth in the series devoted to Soviet engineering plants, the activities of the First State Ball Bearing Plant, Moscow, are discussed. This plant produces 70 million ball and roller bearings per year, of all types, in a wide range of sizes, and considerable attention has been paid to work handling and loading. A typical loading mechanism for a multi-spindle chucking automatic is described, and the layout of a grinding department with mechanized work transfer for a range of bearing races is considered. There is a semi-automatic ring rolling installation arranged for high-frequency induction heating and mechanical segregation of correct and incorrect rings, and an induction hardening furnace for needle roller outer races with automatic loading, and details of both units are given. The latter part of the article is devoted to the completely automatic plant for the production of one size of ball bearing and one size of taper roller bearing. In particular, reference is made to certain work handling arrangements, automatic inspection machines, and the equipment for assembling, wrapping and packing the bearings. (MACHINERY, 93—15/10/58.)

Production of Very Accurate Components for Electro-mechanical Control Equipment P. 882

In this article, the methods employed by the Autonetics Division of North American Aviation, Inc., California, U.S.A., for the production of such items as optical lead-screws for navigation systems, involute cams, and other items, are discussed. The total error in the 7-in. thread length on the lead screws must not exceed 12 micro-inches, and the same limit is specified for "drunkenness." After rough- and finish-grinding operations, the thread is lapped on a vertical machine. Two sets of counter-balanced half nuts are used, and the time required to lap one screw is 12 hours. Involute cams are produced to within 6 micro-inches for accuracy of profile, and the cam surfaces must have a finish of 2 micro-inches r.m.s. For machining a series of lands on a component for a solenoid-operated valve, a Hardinge chucking lathe is used. Each land is 0·008 in. wide, and a finish of 32 micro-inches r.m.s. is specified. A stepped gun drill, in conjunction with coolant at a pressure of 300 lb. per sq. in., is used for machining pitch-damper housings on a Jones & Lamson turret lathe. (MACHINERY, 93—15/10/58.)

Derota Wire- and Strip-forming Machine P. 887

Platarg Manufacturing Co., Ltd., Shortlands, London, W.6, have recently introduced a wire- and strip-forming machine, known as the Derota, which is capable of producing a wide variety of components at the rate of 38 to 110 per min. Within this range, the speed is steplessly variable. Four cam-operated form-tool slides are provided, the phasing and timing of which are readily adjustable. At one typical set-up, which is described, formed links are produced from 0·075 in. diameter brass wire at the rate of 110 per min. (MACHINERY, 93—15/10/58.)

Machining Operations on Honeycomb Material .... P. 903

Increasing use is being made of metal honeycomb material in bonded aircraft structures, and this article is concerned with the developments which have been made as regards machining this type of material at the Northrop Division of Northrop Aircraft, Inc., Hawthorne, Calif., U.S.A. The aluminium sheet used for the honeycomb structure is frequently only 0·0007 in. thick, and the heaviest sheet employed is 0·002 in. thick. The honeycomb core is attached to a skin or "caul plate" by means of polyethylene glycol, a water-soluble wax-like material which has excellent gripping properties at room temperature, but can be melted and removed from the work by washing in hot water. To machine the honeycomb, a "truck-valve" type of cutter is used, which resembles the valve from a commercial vehicle engine. The edge of the head portion is kept razor-sharp, and the cutter is operated at between 5,000 and 6,000 ft. per min. A manually-controlled Wadkin router, with a 25-ft. long table, is described, as is a planer-type machine for producing wedge-shaped honeycomb parts. For wing sections in which the geometry is such that the construction lines all terminate at a common intersection point, an "apex"-type of machine is installed. The cutter head is mounted on a cross rail, one end of which is pivoted at the common origin point, and can be traversed along this rail by a lead screw. (MACHINERY, 93—15/10/58.)

Verdict-Dow Dial Indicator Gauging Equipment .... P. 907

A range of dial indicator gauging equipment is now being made in this country by A. Capp & Son, Ltd. Crayford, Kent, under licence from the Dow Mechanical Corporation, U.S.A. The equipment comprises a base with a built-in dial indicator, and an adjustable work-holder which enables diameters from ¼ to 1 in. to be inspected. The patent Dow Tacomp dial indicator comparator, which is primarily intended for the accurate inspection of tapers for angle, is also described. (MACHINERY, 93—15/10/58.)

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If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

Employment in the Metal Industries

Although, according to the latest provisional figures issued by the Ministry of Labour and National Service, there was a further increase in the number of persons registered as unemployed during the period ended September 15, there was a rise of 33,000 during the month of August in the total of those in civil employment. The estimated number unemployed in Great Britain on September 15, including those temporarily stopped, was 476,000, as compared with 445,600 on August 11, and 395,500 on January 13, and was higher than the average figure for any year since 1947. Despite the increase in civil employment in August, moreover, the total at the end of the month (23,127,000) was still 209,000 below the figure for the end of August, 1957, and this decline, during the 12 months, was attributable to a fall of 210,000 in the manufacturing industries. In this connection, therefore, it is relevant to examine the trend in the vitally important branches concerned with the production and working of metals.

At the end of August, the latest date for which statistics are available, the total number employed in the manufacturing industries was 9,109,000, as against 9,099,000 at the end of July, 9,119,000 at the end of June, and 9,319,000 at the end of August, 1957. Of the main classifications into which the manufacturing industries are divided, "engineering, metal goods, and precision instruments" showed falls in employment from 2,833,000 at the end of August, 1957, to 2,785,000 at the end of June, and to 2,774,000 at the end of July. There was, however, a small but welcome improvement in August which brought the figure for the end of that month to 2,778,000. For "metal manufacture," on the other hand, there was a continued decline from 581,000 at the end of August, 1957, to 558,000 at the end of June, 554,000 at the end of July, and 552,000 at the end of August last. In the third of the main metals groups, which covers "vehicles," employment during the past 12 months has been much more stable. At the end of June the total was 1,241,000, or 5,000 more than at the end of August, 1957. During July it fell to 1,235,000 and remained at this level up to the end of August. The net effect of these changes was that the aggregate number employed in the three groups of industries declined during the 12 months to the end of August last by 85,000 or 1·83 per cent. For all manufacturing industries, the corresponding figure was 2·25, so that the reduction in employment in the principal metal industries was somewhat below the average.

Of those employed in manufacturing industries during the week ended August 23, 160,000 were on short time, as compared with 156,000 during the week ended July 26. Of the total for the latter period, which is the last for which detailed statistics are available, 12,600 was attributable to "engineering, metal goods, and precision instruments," 19,900 to "metal manufacture," and 21,600 to "vehicles." On the average, therefore, 1·19 per cent of the people employed in the three groups at that time were affected. Those on short-time during the August week, in all the manufacturing industries, lost, on average, 14 hours. During the same week, 1,196,000 production workers had an average of 7½ hours overtime. Figures are not yet available to show how many of these workers were employed in the metal industries, but it may be noted the total was 96,000 fewer than in May and 338,000 fewer than a year ago.

On August 11, the number of unemployed attributable to "engineering, metal goods, and precision instruments" was 45,300, to "vehicles" 11,900, and to "metal manufacture," 18,000. In this connection it may be noted that for the first two groups those wholly unemployed accounted for large proportions of the totals, whereas for "metal manufacture," those temporarily stopped represented 41·7 per cent. For the three groups, the total of unemployed on August 11 represented 1·68 per cent of the number employed at the end of July. It may be mentioned in passing that for "machine tools and engineers' small tools" the number of unemployed was 1,075 out of a total of 114,400 (0·94 per cent) whereas for iron foundries the percentage was 3·11, for "iron and steel melting and rolling," 3·86, and for "shipbuilding and ship repairing," 5.

During the five weeks which ended on September 10, the number of vacancies filled by the employment exchanges was 198,800 as compared with 129,500 during the four weeks ended August 6. The number of vacancies which remained unfilled on September 10 was 178,800, and although this figure was 24,000 lower than on August 6, and 104,900 lower than on September 11, 1957, it still amounted to 37·6 of the total of un-

(*Continued on page* 915)

Aspects of Russian Engineering Industry

Some Impressions Based on a First-hand Study of Soviet Plants

The earlier articles in this series[*] have been concerned principally with the development of the Russian machine tool industry, since it is evident that this industry must form the basis of any wide-scale industrial expansion. In this connection, two of the leading machine tool plants—the Ordzonikidze in Moscow, and the Sverdlov in Leningrad—have been described, and certain of their products have been discussed. An efficient machine tool industry should be backed by good facilities for the supply of cutting tools, and the organization and work of the Moscow Cutting Tool Works (MIZ) have been considered, since this plant effectively produces very large numbers of standard and special tools and cutters. A noteworthy feature of the Russian system is the provision of well-equipped research facilities, and in this series of articles two research institutes have been considered. Both these institutes (TsNIITMASh and ENIMS) are situated in Moscow, and collaborate closely with the Russian machine tool plants and with engineering industry generally, and in the immediately preceding article, some of the automated machine lines which have been designed and built by ENIMS for various Russian factories were described. The remaining articles in the series will be concerned with the activities of various factories in Moscow and Leningrad, and the first to be considered is the large plant in Moscow for the manufacture of ball and roller bearings.

FIRST STATE BALL BEARING PLANT

Founded some 25 years ago, the First State Ball Bearing Plant now produces journal, self-aligning, angular contact and thrust ball bearings, and journal, taper thrust and needle roller bearings, in 1,100 different types. The smallest ball bearing made in the plant is 30 mm. (1·181 in.) diameter, for bicycles, and the largest type is a roller bearing for rolling mill applications, which is 1,600 mm. (63 in.) diameter, the weights of individual bearings ranging from 30 gm. (1·06 oz.) to approximately 4 tons. Bearings are supplied to all branches of Soviet industry, including those concerned with the production of motor vehicles, agricultural implements and machine tools, and the output of the plant, where about 20,000 people are employed, is of the order of 70 million bearings per year.

In the plant, there are six departments for the production of precision bearings and those that are required in relatively small quantities, such bearings forming the bulk of the output. There are also five departments arranged for large-quantity production, and a completely automatic plant for the manufacture of certain sizes of ball and roller bearings, which has been in operation since 1956. Reference will be made to this plant later, and it suffices to say here that it is now delivering bearings at a rate of 1,500,000 per annum. A new automatic plant is being developed, based on the experience gained from the present installation, and will provide for the production of four sizes of needle roller bearings. These bearings are now being made at a rate of 15 to 16 million each year, but to meet the increased demands that will arise as a result of the planned expansion of the motor vehicle and tractor industries, the new plant will be designed for an output of 25 million needle roller bearings a year.

Throughout the plant, considerable attention is paid to mechanized work handling, and existing universal or semi-automatic machine tools are being replaced or arranged for automatic loading and unloading. In many sections, these automated machines are being linked to form automatic production lines, and seven such lines are now in operation. One of the largest departments of the plant was being reorganized when the information for this article was being collected, and the work was being carried out without interrupting production. Eventually, this department will have 10 automatic production lines, and four lines were working at the time of our visit. It is planned to complete the automation of the machines for the six lines by the end of 1959, and to have the auxiliary equipment installed and the lines in production by 1961. On the lines at present in operation, it is stated, it has been found possible to increase output by as much as 80 to 100 per cent in certain instances. An increase of 40 to 59 per cent has resulted from improvements in machine output, and a further, similar increase has been achieved by better transportation arrangements for the work and the elimination of unnecessary operations. It is estimated that the cost of introducing such lines will be recovered in two to three years.

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[*] MACHINERY, 93/4—2/7/58; 93/137—16/7/58; 93/174—23/7/58; 93/288—6/8/58; 93/345—13/8/58; 93/456–27/8/58; and 93/572–10/9/58.

At one time, each stage in the production sequence was performed in a different section, but the various stages are now carried out in the required order on the automated lines. Although work is automatically transferred from machine to machine, not all the individual operations have been fully mechanized at this stage. For example, it has not been found economical to assemble certain taper roller bearings automatically, and this work is performed by semi-automatic machines. The use of such machines, however, has enabled the time required for assembly to be reduced to one-fifth of that previously needed when the bearings were manually assembled.

The plant engineers are working on the development of automatic control arrangements for the lines, which will be installed at a later date, and have carried out investigations in connection with the full automation of assembly and inspection operations. A considerable amount of this work has been concerned with automatic gauging and size control for grinding machines, and electrical or mechanical arrangements are being developed in preference to electronic systems. Automatic machines are also being developed for the inspection of completed workpieces, and another field of research is automatic feed-back control for cutting tools. Centralized coolant systems are installed for groups of machines, and in the main entrance to the production shops there is a large illuminated panel to indicate the output of the various sections. Progress is shown by brightly lit arrows and a red star is illuminated when a section is ahead of schedule. At present, due to more efficient production methods, the working shift has been reduced to 7 hours, and workers receive the same wages as for the previous 8-hour shifts.

AUTOMATIC LOADING ARRANGEMENTS

Ten different standard types of automatic loading arrangements for lathes and similar machines have been developed by the plant engineers, and a typical unit for a multi-spindle chucking automatic is seen in Fig 1. Partly-machined bearing outer races are delivered, by way of the chute *A*, from the preceding machine in the production line. The lowermost race is supported by the lower, single claw of the escapement fork *B*. During each loading and unloading sequence, a completed workpiece is withdrawn from the expanding driver on the machine spindle by the gripper unit *C*, and is ejected into the discharge chute *D*. The lowermost race in the chute *A* is then released and the remaining races are supported by the bifurcated upper claw of the escapement fork *B*, the gripper unit being simultaneously withdrawn clear of the end of the chute *A*. Next, the gripper unit is advanced to engage the race and load it on to the driver. The latter is then expanded to grip the workpiece, and the machine cycle is resumed.

The sequence of operations is shown diagrammatically in Fig. 2, which has been lettered to correspond with Fig 1, where appropriate. At stage 1, Fig. 2, workpieces in the chute *A* are seen supported by the single, lower claw of the escapement fork *B*. A machined workpiece on the expanding driver is indicated at *E*. At stage 2, the

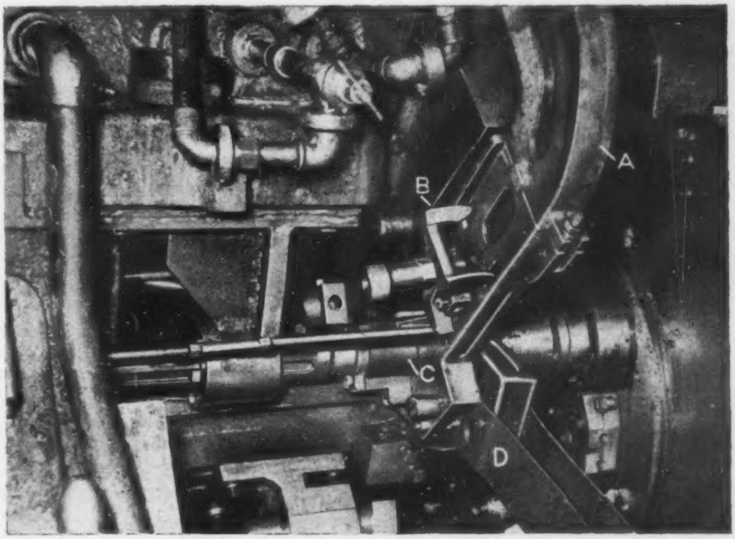


Fig. 1. Close-up view of the automatic work loading and unloading equipment developed for multi-spindle chucking automatics at the First State Ball Bearing Plant, Moscow

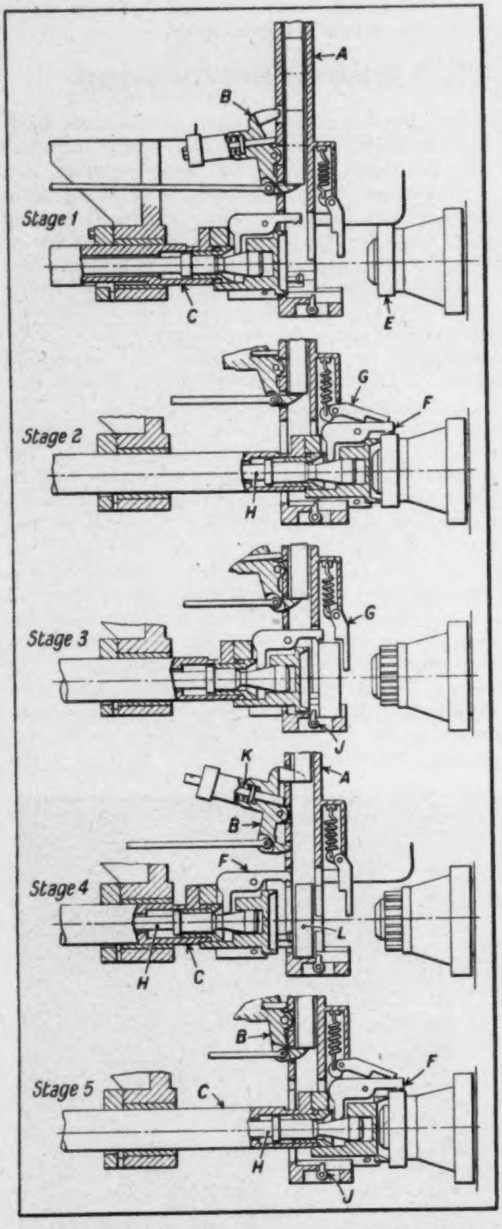


Fig. 2. The sequence of operations for unloading a finish-machined bearing race and loading a partly-machined blank with the equipment seen in Fig. 1, is here shown diagrammatically. After stage 5, the cycle is repeated

complete gripper assembly *C* has been advanced so that the jaws *F* engage the machined workpiece on the driver. During this movement, the upper jaw lifts the spring-loaded retaining member *G*, and the jaws *F* are closed on to the workpiece by the displacement of the conical portion of the sliding plunger *H*.

After the driver has been contracted, the gripper assembly is withdrawn to the position shown in stage 3. In this position, the displacement of the plunger *H* in the opposite direction allows the jaws to open, under spring pressure, and the machined workpiece is ejected by pivoted dogs, as at *J*, and falls into the discharge chute. It will be observed that the retaining member *G* has resumed its original setting, under the influence of its associated spring, and prevents the workpiece from toppling forwards through the open side of the chute.

Withdrawal of the gripper assembly continues until it is positioned as shown in stage 4. By means of a mechanical linkage, the escapement fork *B* is pivoted against pressure applied by the spring plunger *K*. Consequently, the lowermost race in the chute *A* is released, and drops into the position indicated at *L*, the remaining races in the chute being supported by the bifurcated claw of the escapement fork, as shown. Next, the gripper assembly *C* is advanced, so that the jaws *F* engage the fresh race *L*, and the jaws are closed on to the race by displacement of the plunger *H*. Then, the gripper assembly is advanced to the position indidicated in stage 5, carrying the race on to the expanding driver, until it contacts a stop-shoulder. During this movement, the race tilts the dogs *J*, and the escapement fork *B* is returned to its original setting, thus allowing the stack of races in the chute *A* to fall, until the lowermost is supported in the pre-loading position.

Finally, the driver is expanded to grip the race in the bore, the plunger *H* is displaced to open the jaws *F*, and the complete gripper assembly *C* is withdrawn to the position shown in stage 1, in readiness for the next loading cycle.

RING ROLLING MACHINES

Most of the inner and outer races for the bearings produced in the plant are machined from forged rings. Steel for the production of rings, rollers and balls, is obtained from various Soviet plants, and the supplier is responsible for the control of quality, inspectors in the bearing factory carrying out random checks on the incoming material. The bearing factory has its own rerolling plant whereby the steel is reduced to sections suitable for the manufacture of rings, also for

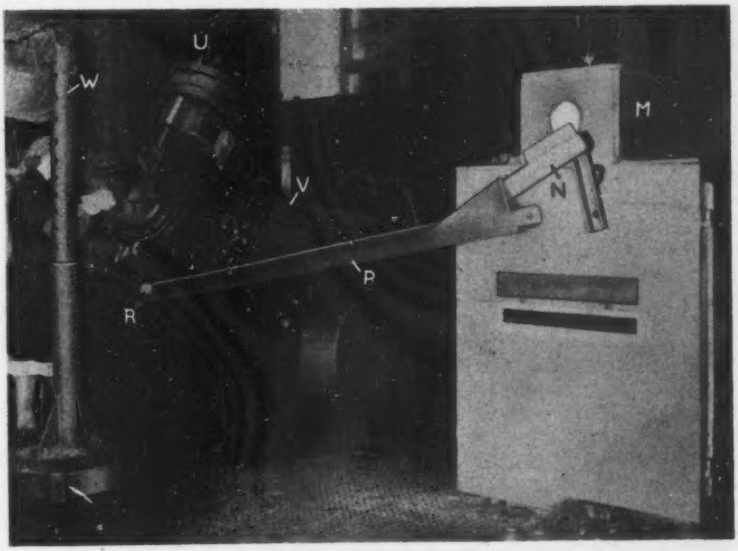


Fig. 3. Special ring-rolling equipment developed by the Bearing Plant. The blanks are induction heated in the furnace at the right, and are fed automatically to the semi-automatic ring-rolling machine at the left

making balls and rollers, which are produced by conventional methods. At one time, the rings were upset-forged, pierced and rolled to produce a rectangular cross-section, but more recently, in order to economize in material, the race track is rough-formed during the course of the rolling operation.

Special ring-rolling equipment has been developed by the plant engineers, and a general view of one installation in the forging shop is given in Fig. 3. Forged rings are loaded into a hopper at the rear of the induction-heating furnace seen at the right. From the hopper, the rings pass down a sloping chute to the entry end of the heating coil, within the housing *M*, and are advanced through the coil by an automatic pusher mechanism. Rings, heated to a temperature suitable for rolling, are delivered from the entry end of the coil at a rate of one every 5 sec., and drop into the chute *N*, down which they roll to the second chute *P*. The lower end of the chute *P*, adjacent to the rolling machine, is closed, and the ring comes to rest in line with a cut-out in the front wall of the chute, which facilitates removal. A ring in this position is indicated at *R*.

The rolling machine is tended by a female operator, who removes the ring from the chute, with the aid of a metal hook, and places it between the two lower rolls of the machine, a ring in the rolling position being visible at *S*. It will be observed that the main frame of the machine is inclined, and the two lower rolls are carried on the ends of stout arms. These arms are connected to a powerful hydraulic cylinder at the rear of the frame. Above the lower rolls is a larger roll *T*, which can be moved downwards by the cylinder *U*. The lower rolls have an annular bead, of a form to suit the track of the rings that are being rolled, and the upper roll is of a cylindrical shape with a flange at each end. The rolling machine operates continuously, and the operator loads and unloads rings in phase with the movements of the rolls. As the upper roll moves downwards, the two lower rolls are swung inwards to form the track, and the metal in the body of the ring is controlled by the face and flanges of the upper roll, so that the bore is reduced slightly in diameter. At the end of their downward and inward movements, the rolls dwell for a brief interval and are then withdrawn. During the withdrawal movement, the operator removes the rolled ring, and places it in the chute *V*, which is fitted with two inclined guide plates. It may be noted that a large cooling fan is mounted on a pillar at one side of the operating position, as indicated at *W*, and a second fan is installed behind the operator.

AUTOMATIC SORTING EQUIPMENT

Rolled rings pass down the chute *V* towards the rear of the rolling machine, and enter a second inclined chute which incorporates equipment (Fig. 4) for sorting them into correct, oversize and undersize grades. Since the limits specified for the rings at this stage are fairly wide, the sorting mechanism is of simple design. The second chute at the end of the chute *V*, Fig. 3 and 4, is inclined in two directions, so that the rings roll downwards in contact with the flat plate *W* at one side. This plate forms the side wall of the chute which is generally of L-section, although a second side wall is provided at the inlet end, and is inclined to form

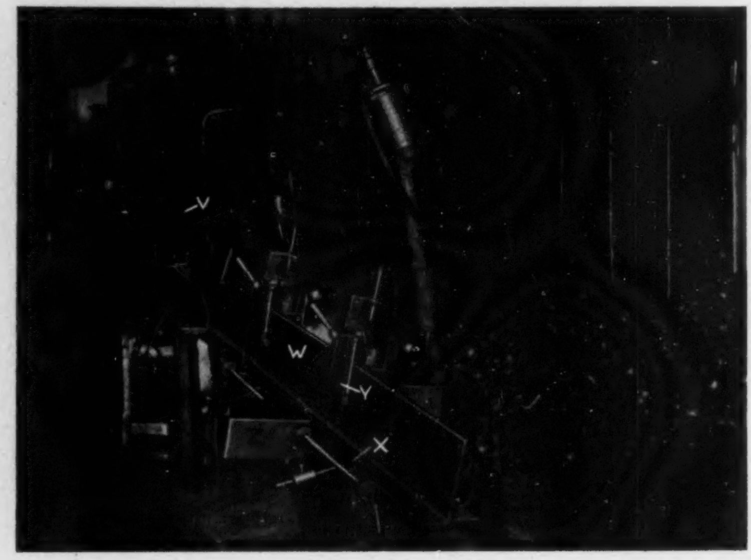


Fig. 4. Equipment for sorting the forged rings into correct, undersize and oversize grades is incorporated in the outlet chute from the rolling machine. As each ring rolls down the chute, it trips one of two blades to actuate deflector flaps if it is correct or oversize. Undersize rings roll on into a work-pan

a lead-in for the rings as they drop from the chute *V*. This side wall, also one side wall of the chute *V* can be adjusted sideways to provide for the passage of rings of different widths.

The bottom of the lower chute is made in five pieces, three of which are rigidly secured to the supports for the plate *W*, and these pieces are separated by plates, as at *X*, which are hinged at one side. A bar projects outwards from one side of each hinged plate and carries an adjustable weight which is set to ensure that the plate is swung into the position shown, in line with the other bottom members of the chute, but the combined weight of the plate and a rolled ring is not counterbalanced. Each hinged plate is retained in the position shown by a simple latch, which is coupled to a shaft carried in a bracket on the side of the plate *W* remote from the hinged plate. A support member is fitted to the shaft whereon a steel blade, as at *Y*, is adjustably mounted, the blade extending downwards over the chute, approximately over the mid-point of the hinged plate *X*.

As has already been mentioned, there are two such assemblies comprising a blade, shaft and latch and the blade *Y* is set so that the distance from its lower edge to the surface of the hinged plate *X* is equal to a specified minimum diameter of the rings. The second blade, towards the upper end of the chute, is set so that its lower edge is at a height corresponding to the specified maximum diameter of the rings. If an undersize ring travels down the chute, it can pass beneath both blades and continue its movement until it rolls off the lower end, into a scrap bin. An oversize ring makes contact with the upper blade causing it to pivot and thus releasing the latch that retains the associated hinged plate in the bottom of the chute. Under the weight of the ring, the plate tilts downwards, and the ring slides out of the chute and into a scrap bin on the right-hand side (as viewed in Fig. 4). Rings that are within the prescribed tolerances pass under the upper blade but contact the blade *Y*, and are ejected sideways as the hinged plate *X* is tilted, so that they fall into a large steel basket, housed in a pit in the shop floor, at the right of the chute. When the oversize and correct rings are clear of the hinged plates, the latter are returned by the actions of the counterweights, and the latch mechanisms are reset.

A counter unit Z is tripped each time the hinged plate *Y* is tilted, and the number of correct rings is recorded. These rings are cooled by a water spray directed into the basket from a nozzle which is mounted on a pillar at one side of the pit, and the basket is removed at intervals by an overhead crane and an empty basket substituted.

INDUCTION HARDENING NEEDLE BEARING RACES

The plant engineers have developed automatic equipment for induction-hardening and tempering the outer races for needle roller bearings, and Fig. 5 is a view of the loading end of the installation. Outer races are delivered to the loading station in work pans, and are tipped into the hopper

A. The races pass through an opening in the bottom of the hopper and enter the drum of the sorting unit *B*. Within the drum, there is a circular plate which is driven from the motor *C*, through reduction gearing and a V-belt. Blades fitted to the plate churn the outer races so that they pass between the vertical plates *D*, at the bottom of the drum. These plates form part of a conveyor whereby the outer races are transported, with their axes at 90 deg. to the direction of travel, and races are delivered to a multi-track rotary feeder on the far side of the sorting unit *B*.

One side of the rotary feeder is just visible at *E*, and it has five tracks, corresponding to the spaces between the plates *D*. The tracks are formed by concentric hoops of steel strip, supported above a rotating disc, and the races are carried round the tracks by the movement of the disc. They are discharged into the entry chute for the vertical elevator *F*, which consists, basically, of a driven loop of chain, with inclined flight bars, between two side plates.

The entry chute is inclined, and the races move downwards, each, in turn, coming to rest on a flight bar, whereby it is carried upwards. At one side of the elevator, there is a sensing unit which detects whether the open or internally-flanged end of each race is to the left. Those races that are not correctly positioned are ejected, turned through 180 deg., and returned to the entry chute of the elevator.

At the top of the elevator, the races pass into a gravity feed chute *G* as the chain passes over the upper sprocket. This chute curves to the left as it descends, and connects with a zig-zag section leading to the entry chute at the side of the induction heating furnace *H*. The combined length of the zig-zag portion and the chute *G* enables sufficient races to be stored to allow for interruptions in the supply to the hopper *A*, or stopping of the elevator and feeding mechanism. At the upper end of the chute *G* there is a limit switch *K*, and if the number of races in the chute is such that this switch is tripped, the elevator and feeding mechanism are stopped, thus preventing further build up of parts should the furnace be inoperative.

From the inner end of the entry chute of the induction heating furnace, the races are advanced through the heating coil by a mechanical ram, with their axes at 90 deg. to the direction of movement. From the end of the heating coil, the races fall directly into an oil quenching bath. An inclined chain belt, with transverse blades, carries the hardened races from the bath into a washing unit, whence they are conveyed through a drying unit into a tempering furnace. The induction heating furnace, quenching bath, washer, and tempering furnace are arranged in line and are automatically controlled. Hardened and tempered races are delivered at a rate of 2,500 per hour.

PARTIALLY AUTOMATED LINES FOR GRINDING RACES

It has already been mentioned that the automation of certain of the production lines is being carried out in stages, and at the time that information for this article was being obtained, certain lines for grinding the outer races of taper roller bearings had been provided with conveyors for the transport of workpieces, but the machines had not been equipped for automatic work loading. The grinding machines are arranged down both sides of the bays in one of the main buildings of the plant, and each line of machines is fed with races from a conveyor system, installed below the roof structure.

It may be of interest to mention here that the building is similar to many others seen during our

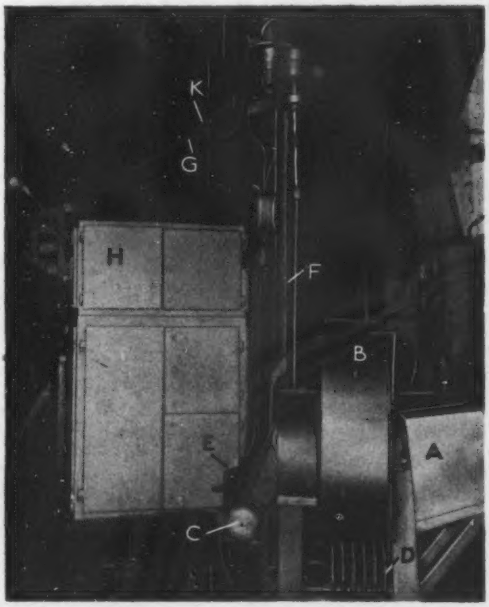


Fig. 5. For hardening and tempering outer races for needle roller bearings, the plant engineers have built this automatic equipment. From a hopper, races are sorted and loaded into an induction heating furnace, whence they drop into a quenching bath. They are then conveyed through the tempering furnace, and a throughput of 2,500 races per hour is maintained

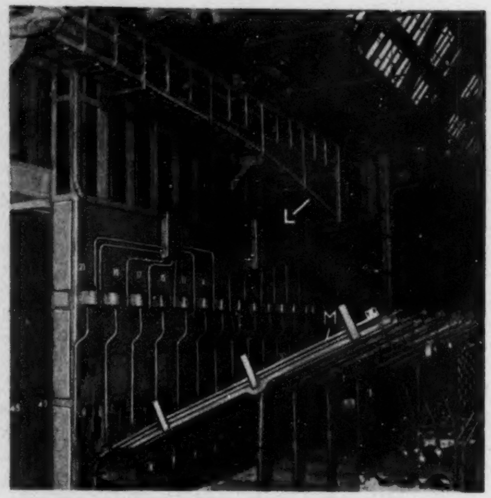


Fig. 6. The starting end of one of the partly-automated grinding lines for bearing races at the First State Ball Bearing Plant, Moscow. Races are delivered in barrows, and are loaded into the sloping chutes which feed elevator units. These elevators deliver the races to an overhead conveyor

visits to Soviet plants, and was mainly of reinforced concrete construction. There is a row of columns down the side of each bay, and each column has a cross-member at the top, so that it resembles an elongated "T." Each row of T-shaped columns supports a flat reinforced-concrete roof, the width of this roof section being slightly greater than the length of the column cross-members. The space between adjacent concrete roof sections is spanned by a wooden structure, with brick ends, the cross-section of this structure resembling an inverted, flattened "V." Each side of this structure is glazed to provide for natural illumination of the bay, and the general arrangement may be seen in Figs. 7 and 9, for example.

A view of the entry end of one grinding line is given in Fig. 6, where the loading arrangements for the work-transfer conveyor may be seen. Basically, the conveyor consists of a shallow trough along which the workpieces are moved by scraper blades attached to a pair of chain loops. The lower run of these chains is indicated at *L*, and the chains pass round a pair of idler sprockets at the entry end of the line. Intermittent motion is imparted to the chain by a sprocket coupled to a hydraulic cylinder at the opposite end.

At the entry end of the line, there is a series of inclined chutes, as at *M*, each chute being supported on a screw-adjustable column, and sloping downwards towards a battery of elevator units *N*. Races in a range of 12 different sizes are delivered in hand-barrows or power-driven trucks, and races of each size are loaded into a specific chute. To facilitate identification of the chutes, each has a hook at the entry end, whereon a sample workpiece is hung.

Races in any one chute slide downwards, on their sides, until they are arrested at the lower end by an escapement mechanism, actuated by the

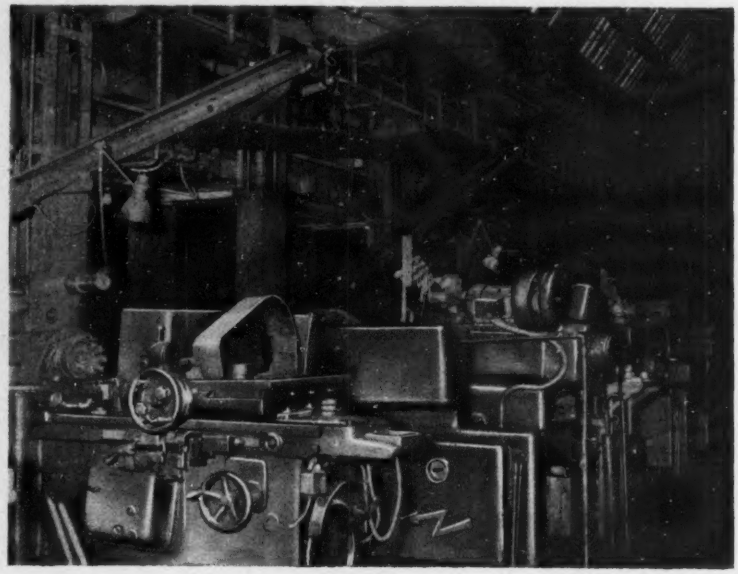


Fig. 7. Part of another partly-automated line for grinding bearing races. Workpieces of various sizes are transported by the overhead conveyor, and those of the required size are delivered by chute to each grinding machine

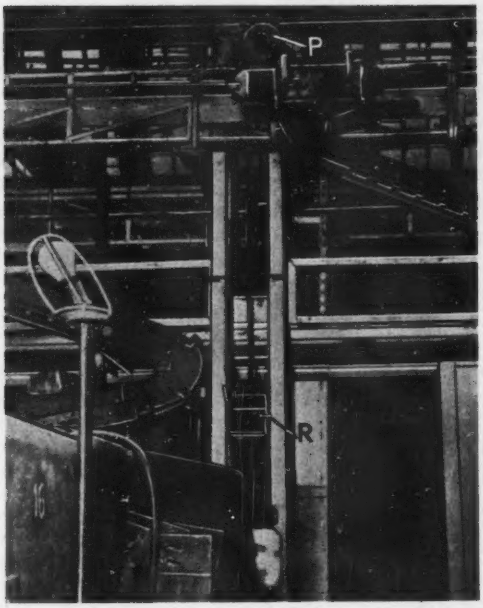


Fig. 8. Close-up view of an elevator on one of the grinding lines whereby ground races are returned to the overhead conveyor for transport to the inspection section at one end. The elevator pan is coupled to a chain which is driven from the main scraper chain of the overhead conveyor

elevator. One race at a time is released, in phase with the movement of the elevator pan, and is carried upwards and discharged on to the conveyor trough, below the upper run of the chains and the scraper blades. The conveyor serves for the transport of all the different sizes of workpieces that are ground on the line, and the elevators are numbered to correspond with the machines in the line, of which there are 14 in this instance. The elevators are of a chain and pan type, the elevator chain being driven from the upper run of chain of the transfer conveyor.

Fig. 7 shows part of an adjacent line for grinding bearing races, and, here, a generally similar work transfer system is employed, although the arrangements differ slightly in detail. Again, the main transfer conveyor is mounted below the roof support members, and there are inclined chutes for delivering workpieces to the machines. At the head of each chute, there is a trip-operated ejector mechanism, whereby races, of a suitable size for the machine served by the chute, are ploughed out of the trough, and through an opening at one side. A short section of chute, curved in two planes, connects the opening with the main run of the down-feed chute, and the lower end of this chute is also curved, and ends at a convenient position for unloading, close to the headstock of the grinding machine. From this end of the chute, one race at a time is removed by the operator, and is loaded into the diaphragm chuck mounted on the machine spindle.

The machines in this section—36 in number—are hand operated, but are fitted with gauging units which indicate the diameter of the bore as it is being ground. Under the control of the operator, grinding is continued until the size indicated on the gauge is within the prescribed tolerance zone, this zone being indicated by pointers on the gauge dial. The smallest races are ground on the machines at the entry end of the line, and the size of race that is ground increases progressively along the line, the largest races being ground at the discharge end.

After each race has been ground it is removed

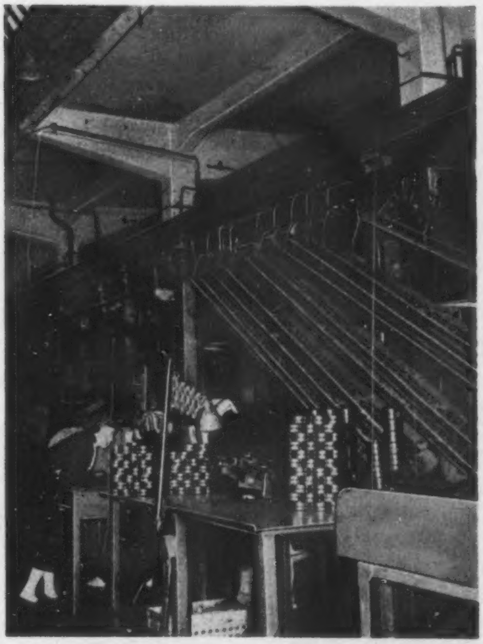


Fig. 9. The inspection section of one of the partly-automated grinding lines. Races are sorted into the different sizes as they pass along the conveyor trough and are ejected into the appropriate gravity feed chutes, leading to the checking benches

from the chuck and is placed in a gravity-feed chute which leads to an elevator of a type similar to those seen in Fig. 6. Such an elevator, on a neighbouring line, is shown in Fig. 8, and the sprocket whereby drive is taken from the main conveyor chain is indicated at *P*. The cage of the elevator is seen at *R*, during the course of its upward travel, and one end of a length of roller chain is coupled to the top of the cage and the other end to the bottom. The loop of chain passes over a driven sprocket at the upper end of the elevator and an idler sprocket at the lower end. Pivoted in the cage is a pan of an L-shaped cross-section, and the pivot pins pass through lugs that project from the under-side of the longer leg of the L-form, so that the pan tilts towards the rear. When the cage reaches the top of the elevator, a peg on the pan contacts a stop-member on the elevator frame, and the pan is tilted forwards. The arrangement is such that when a ground race is placed in the pan, the inclination of the latter prevents the race from falling out as the cage is lifted, and tilting of the pan at the end of its travel discharges the race into the main transfer conveyor trough.

Ground races are delivered by the main conveyor to an inspection bay at the end of the line, and there is a series of ejector mechanisms whereby each size of bearing is transferred to one of a group of gravity-feed chutes, as seen at the right in Fig. 9. The bearings are checked by female inspectors, who use bench-mounted multiple dial gauging fixtures.

AUTOMATIC BEARING PLANT

The automatic installation for the production of certain sizes of ball and roller bearings at the First State Ball Bearing Plant has aroused considerable interest, and the arrangements have been described at some length in the Russian journal *Stanki i Instrument* and elsewhere, so that it is unnecessary to discuss them in detail here. Suffice it to say that there are four machining lines, two for the production of inner and outer components for taper roller bearings from forged rings, and two for the production of similar members for ball bearings, from tube.

Ring forgings are loaded into large rotating hoppers on the shop floor, and are fed by conveyor to 4-spindle, double-end automatics. There are three automatics for machining inner races and three for outer races, a generally similar procedure being followed for both types of workpiece. One side and the bore of each workpiece is machined at one end of a machine, and the ring is then transferred by a hydraulically-operated shuttle above the work area to the other end, where operations on the other side of the ring are performed. Machining of the outer races is completed on the automatics, but the inner races require subsequent operations for forming certain undercuts and chamfers. Inner and outer races are ejected into a chute from the last spindle position of each automatic and are delivered to a transfer conveyor. Outer races pass directly to a special horizontal, hydraulic marking press, and inner races are delivered to one of three 2-station automatic lathes for the secondary operations, before they are fed to a marking press.

Inner and outer races for ball bearings are machined on multi-spindle bar automatics, of conventional type, from which they are ejected into chutes and conveyed to automatic marking presses. Races for both ball and roller bearings are transferred by overhead conveyors from the marking presses to large storage maga-

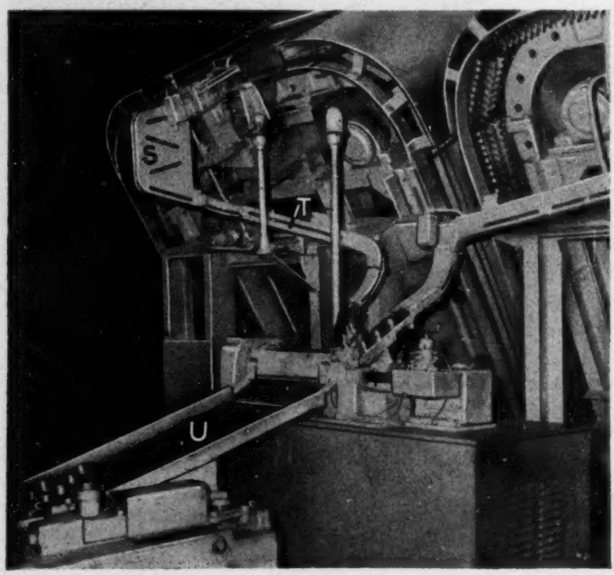


Fig. 10. A pair of storage magazines in the automatic ball and roller bearing plant. Ball bearing inner races are placed in outer races, and both are fed, in rows of five, to the end of the automatic heat-treatment line

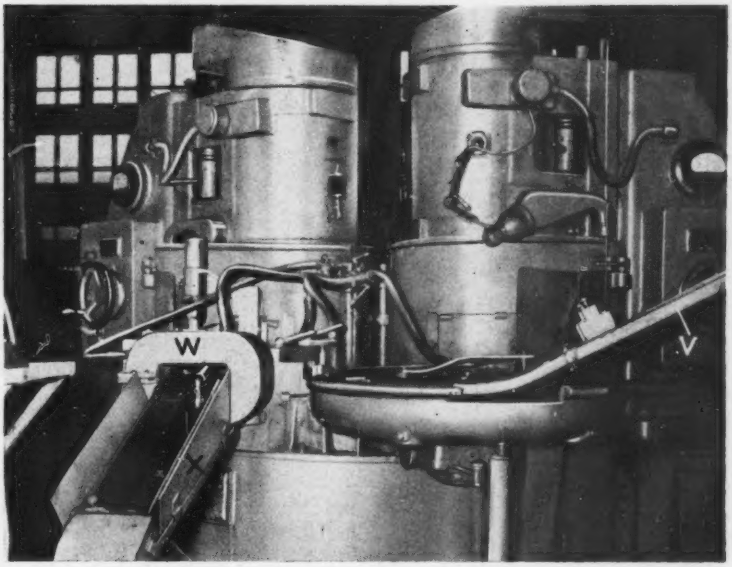


Fig. 11. Two twin-head rotary table surface grinding machines provide for finishing each side of the bearing races in two stages. Each machine is equipped with a disc feeder and a demagnetizing coil, and a turn-over unit is installed between the machines of each pair

zines which feed races to automatic heat-treatment furnaces, and a view of the discharge ends of the pair of magazines for ball-bearing inner and outer races is given in Fig. 10. Both magazines deliver workpieces to a single automatic line which provides for the heat-treatment of both races.

Each magazine has an inclined frame, constructed by welding from steel sections, and supported in bearings at the corners of the frame are four shafts which carry sprockets for loops of coarse-pitch roller chain. Rectangular section tubes are secured to the chain, in banks of eight, for convenience, and each tube incorporates a trip member at its lower end. The transfer conveyor from the multi-spindle bar automatics connects with a vertically-disposed zig-zag chute, the lower end of which is located on the far side of the magazine (as viewed in Fig. 10), in line with the lower horizontal run of the chain-mounted tubes. Under automatic control, the chains are moved intermittently, and each tube in turn is aligned with the end of the zig-zag chute. With a tube in this position, an electrically-operated stop is withdrawn, and races pass from the chute into the tube, and, due to the inclination of the latter, roll downwards until the leading race is arrested by the trip member at the lower end. When the tube is full, the stop is reset to hold back the races in the zig-zag chute, until the next tube has been indexed into position.

The tubes are moved round the magazine frame in a clockwise direction, as viewed in Fig. 10, and are advanced, in turn, to a position in line with an outlet chute, approximately midway along the lower side of the upper run of the magazine chains. When a tube is aligned with this chute, the trip at its lower end is automatically released, and the stored races pass out of the tube into the outlet chute, and thence into a zig-zag section S which ensures that they do not move downwards into the gravity-feed chute *T* at an excessively high speed. When all the races have passed into the zig-zag chute, the magazine chains are indexed to bring another fully-loaded tube into the unloading position. Should the races not be discharged from the chute *T*—due, for example, to an interruption in the heat-treatment cycle—they build-up in the chute S until a limit switch at the head of this chute is tripped, and movement of the magazine chains is stopped until the races pass clear of a second switch, towards the lower end of the chute *T*.

At the lower end of the chute *T*, there is a curved portion whereby the races are re-orientated, so that instead of rolling they slide on one side face. This curved portion of the chute leads to a distributor unit, which is also served by the outlet chute from the second magazine. Between the two outlet chutes there is an escapement mechanism with a detent member which is oscillated by the action of a drum cam to allow a race to pass out of the end of each chute alternately. There is a second cam which actuates a pusher unit, also a metal flap that extends across the broad chute *U*, leading to the hardening furnace. The arrangement is such that an outer race is delivered from the outlet chute of the right-hand magazine to the head of the chute *U*, and rests against the flap. It is then advanced by the pusher to a position below the outlet chute of the left-hand magazine, and an inner race is deposited within the outer race. Next, a second outer race is delivered and advanced to receive an inner race, and the first pair are thrust towards the left-hand side of the chute *U*. When five sets of inner and outer races have been built up in this manner, the flap is raised and the races slide down the chute *U*, on to the shaker hearth of the furnace.

Generally similar magazines are provided for the inner and outer components of roller bearings, but each delivers workpieces to a separate heat-treatment line. All three heat-treatment lines (comprising one for ball bearing inner and outer races, one for roller bearing outer races and one for roller bearing inner races) are completely automatic and incorporate facilities for sub-zero treatment after the hardening quench. For this treatment, the workpieces are maintained at −14 deg. C. for 40 min.

Heat-treated workpieces are fed into storage magazines of the kind described, one magazine being provided for each type of component. From the magazines for ball-bearing inner and outer races, workpieces are fed to the first of two twin-head, rotary table surface grinders, as seen in Fig. 11. These machines were built by the Moscow Grinding Machine Plant and are of conventional design. Workpieces pass down the inclined chute *V* to a rotary feed unit, and enter the tracks between the edge of the feeder bowl and arcuate strips. They are advanced round the tracks by the rotation of the feeder disc and delivered to the rotating magnetic chuck of the grinding machine. There are two grinding heads on this machine, the first providing for roughing and the second for finishing, and as the races are ejected they pass through a demagnetizing coil *W*. A jet of water is directed down the inclined discharge chute *X* to lubricate the chute and to assist the movement of the workpieces.

From the first rotary surface grinding machine, the workpieces pass through a turn-over unit and are then delivered to a second machine of the same type, on which the other face of each race is ground. Inner and outer components for roller bearings are ground on two similar machines arranged in a line parallel to the ball bearing machines, and after face grinding has been carried out, all races are transferred to separate magazine units of the type already considered. The face grinding machines have a higher rate of throughput than the preceding sections or the following grinding lines, and are only used for part of each shift, the magazines serving to balance the flow of work through the various sections.

All the remaining grinding operations are carried out on standard or special centreless machines, with magazines where necessary to balance the rate of work flow. Fig. 12 shows the discharge side of the second unit of a pair of centreless machines for grinding the external surfaces of ball bearing outer races. Workpieces are fed to the grinding throat of the first machine, between the first and second machines, and away from the second machine by means of special conveyor units such as that seen in Fig. 12. The complete conveyor unit is self-contained and is mounted on a trolley which can be moved on rails on the shop floor to provide access for servicing and maintenance. Races are supported on

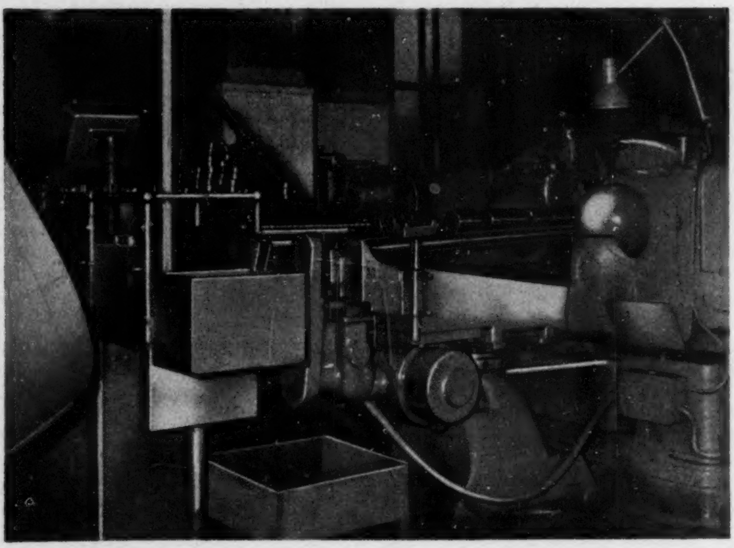


Fig. 12. The discharge side of the second of two centreless machines for grinding the external surfaces of ball bearing outer races, showing the separately mounted conveyor leading to an automatic gauging station

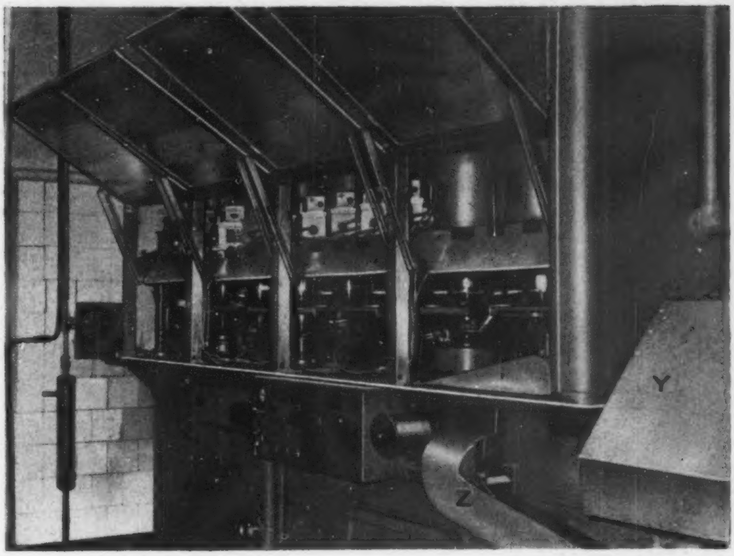


Fig. 13. This automatic gauging machine provides for checking more than 30 different dimensions. It is installed in the assembly line for the inner races of taper roller bearings, and similar machines are provided for outer races, also for the races of ball bearings

two long taper rolls, driven by an electric motor through reduction gearing and roller chain, and the frame supporting the rolls, motor and drive mechanism can be screw-adjusted for height.

Races are delivered by the rolls to an automatic inspection unit, and each race is carried by a plunger between the anvils of a caliper-type air gauge. This gauge is connected to a manometer tube containing mercury, and the movement of the mercury in the tube, relative to a series of contacts, is employed to open or close electric circuits. Through associated control mechanism, deflectors are opened or closed in the outlet chute of the gauging unit, and as the race passes down the chute, after it has been removed from the plunger, it either proceeds to the loading station of the magazine at the left, or is deflected into separate workpans for oversize or undersize parts.

At the end of each grinding line, after the machine for finishing the bores of the races, there is a visual inspection station, from which the workpieces are delivered to an automatic washing installation. When the races are discharged from this installation they are at a temperature of 20 deg. C., and they are transferred by conveyor through the end wall of the main shop into a separate room which houses the automatic inspection and assembly equipment for both types of bearing. This room is fully air conditioned, and is maintained at a temperature of 20 deg. C.

AUTOMATIC INSPECTION EQUIPMENT

Similar automatic inspection equipment is installed on all four lines, and the machine in the line for the inner races of taper roller bearings is shown in Fig. 13, with the delivery conveyor, and its associated opening in the wall of the inspection room, in the background. The machine provides for checking more than 30 different dimensions, but not all stations are employed. From the transfer conveyor, each inner race is transferred by a mechanically-operated horizontal shuttle bar from station to station in the machine, and above each station there is an air operated ram, with a work-carrying arbor at its lower end. As the ram is moved downwards, the arbor engages the bore of the race, which is retained by the pull of an electro-magnet fitted to the arbor, and the race is lowered to the gauging station below. Where necessary, provision is made for rotating the arbors and work—for example, at those stations where the circularity and concentricity of the race is checked. Electro-pneumatic gauging elements are fitted, and the condition of the work at each station is indicated by signal lamps on the panel at the front of the machine.

The checking machine is totally enclosed, with transparent plastics guards in front of the gauging stations, and to allow the mechanism to be seen, these guards were raised before the photograph for Fig. 13 was taken. Races that fail to pass any of the various checks are discharged by way of chutes, such as that at Z, in Fig. 13, and are segregated into scrap and rectifiable groups. Satisfactory workpieces are delivered to a transfer conveyor beneath the housing Y, leading to an automatic machine for the assembly of rollers and cages to the inner races.

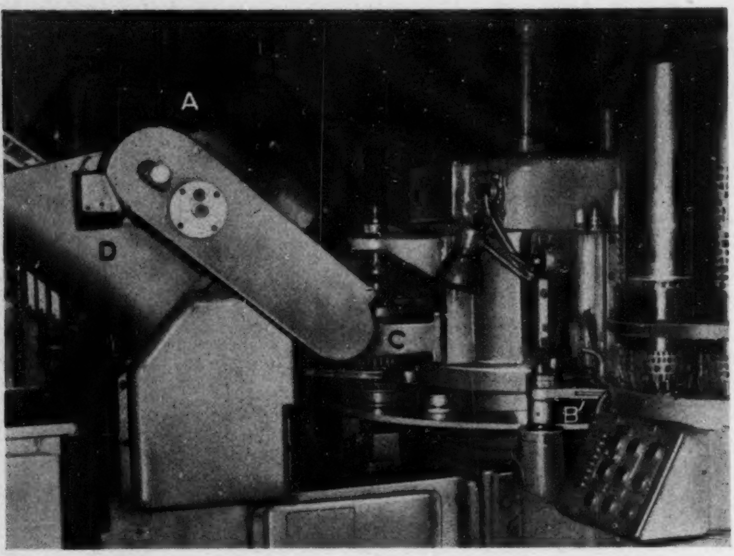


Fig. 14. The automatic machine for assembling cages (from the magazines at the right) and rollers (from the hopper at the left) to inner races of taper roller bearings. It has an indexing table with four work stations

AUTOMATIC ASSEMBLY MACHINE FOR ROLLERS AND CAGES

A view of the automatic assembly machine is given in Fig. 14, and the housing of the inspection equipment is just visible at *A*, in the background. The assembly machine has a large indexing circular table, at one side of which there is a second indexing table with multiple magazines for pressed steel cages, the latter being delivered from the appropriate department of the main factory. Stacks of cages in the magazines may be seen at the right in Fig. 14, and magazines can be reloaded without stopping the machine. From the lower end of the magazine adjacent to the indexing work table, one cage at a time is transferred to one of the stations of the table by a swinging arm *B*, which has a gripper finger at its free end. At each table station, there is an annular member to support the cage, and this member is free to slide vertically.

The table is indexed through 90 deg., and the cage is carried to a position beneath the roller assembly head *C*, which is supported on a bracket fitted to the central column of the machine. Rollers are loaded into the rotary hopper *D*, and are automatically aligned correctly and fed downwards to a drum in the head *C*. This drum has scallops in its periphery, to receive the rollers, and can be intermittently rotated, through a bevel gear drive, by mechanism in the central column. As the drum is rotated, one roller at a time is loaded into a scallop, the number and angular position of the scallops corresponding to those of the slots in the cage. Below the work station, there is a mechanically actuated ram whereby the annular support member is raised, thus lifting the cage into contact with the bottom of the drum, where it surrounds a conical guide member, also with scallops in its periphery. Then, the rollers are released from the drum, and pass downwards, between the guide member and the cage, until they finally come to rest in the cage slots. Next, the cage is lowered to its original position as seen in Fig. 14.

The roller assembly station is adjacent to the end of the transfer conveyor from the inspection machine, and the end of this conveyor is indicated at *E* in Fig. 15, where the storage hopper for rollers is seen at *D*. An inner race is lifted from the end of the transfer conveyor by the swinging arm *F*, and is deposited in the roller-cage assembly. After the arm has withdrawn, the machine table is again indexed through 90 deg., to position the inner race beneath a vertical ram, which presses it into the roller-cage assembly. During this movement, the inner race passes beneath the wiper-blade *G*, and if this blade is not lifted, due to a race not being correctly positioned, the machine is stopped and a pilot lamp above the central column is lit.

From the pressing station, the complete inner race assembly is carried by the next indexing movement of the table to an ejection station, where it is transferred to a delivery chute at the rear of the assembly machine (as viewed in Fig. 15). This chute may be seen at *H* in Fig. 16, and it leads to a visual inspection station, to which outer races are also delivered from the automatic inspection installation *J*. The female inspector at this station assembles the outer race to the inner race assembly, and places the complete taper

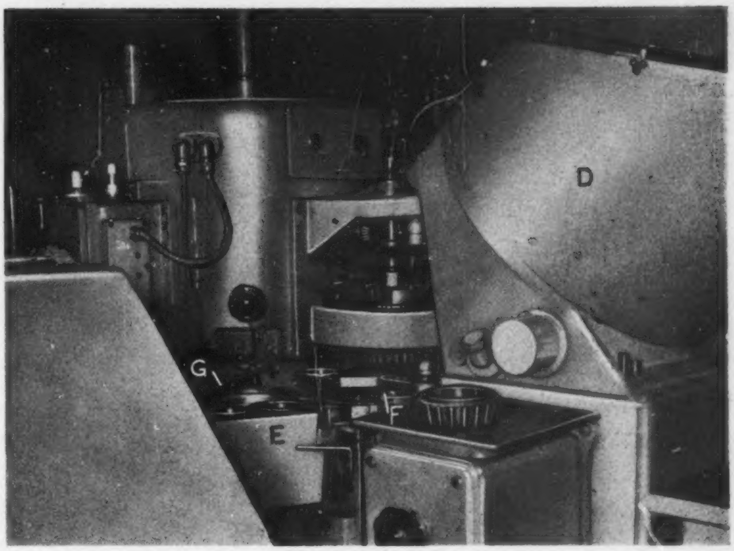


Fig. 15. Another view of the automatic assembly machine, Fig. 14, showing the delivery conveyor for inner races. An inner race may be seen during transfer from this conveyor to the ball-loading station, where it is inserted in the assembled cage and rollers

roller bearing on the inlet chute of another automatic inspection machine, at the right in Fig. 16. This machine is similar in design to that already described, and provides for final checking of the assembled bearings.

AUTOMATIC PACKING AND WRAPPING

Bearings that pass all the final checks are delivered, by the transfer shuttle of the inspection machine, to a conveyor that passes through the wall of the assembly and inspection department into an adjoining section where wrapping and packing is carried out. Fig 17 is a general view of the equipment in this section, and the bearings are first passed through a demagnetizing unit, in advance of the automatic washing plant *K*. Before a bearing enters this plant, the outer race is lifted off the inner race assembly and is transferred to a parallel conveyor track. Moving in phase, the outer race and the inner race assembly are urged along the parallel tracks by a horizontal shuttle

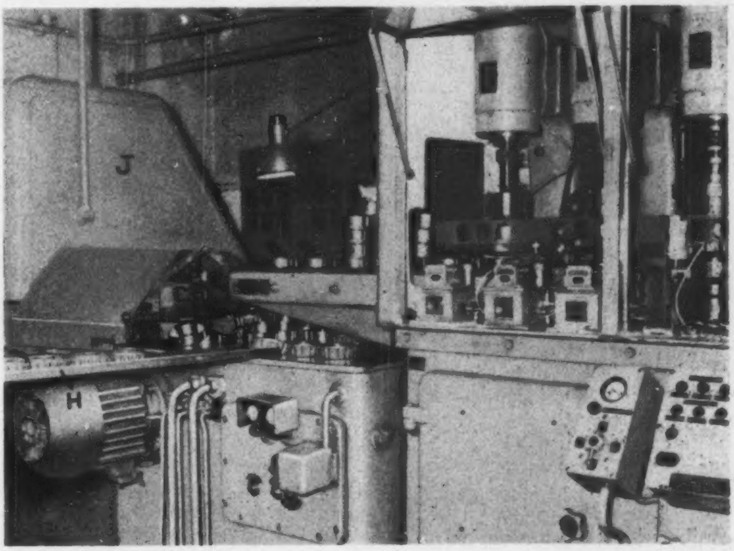


Fig. 16. From the assembly machine, inner races are delivered to a visual inspection station to which outer races are fed from the inspection machine in the background. The outer race is assembled by the inspector, who places the complete bearing in the entry chute of the final inspection machine at the right

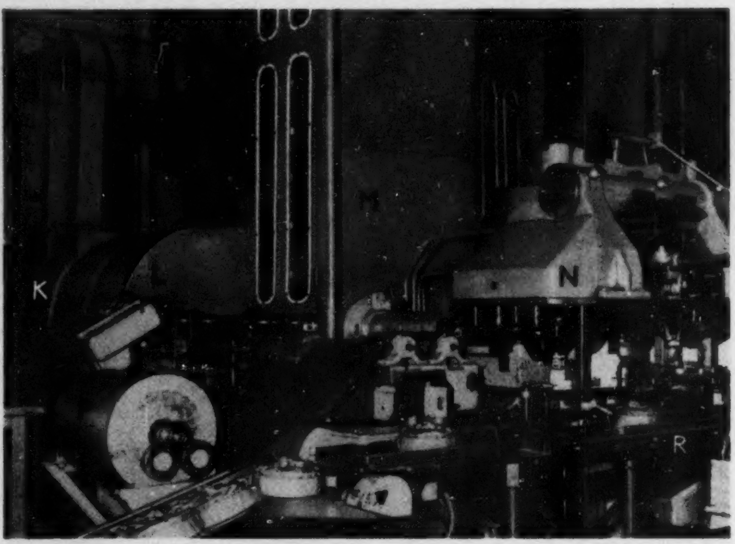


Fig. 17. The installation for automatically washing bearings, applying a protective coating, and then wrapping the inner race and outer race separately. After wrapping, the inner race is placed in the outer race and the pair is delivered by conveyor to a packing station

bar at the side of each. The clean components are dipped in hot grease in the unit *L*, and are then delivered to the loading stations of two closed-loop vertical conveyors within the housing *M*. These conveyors provide for cooling the components and hardening the protective coating, and an outer race on one side, and its associated inner race assembly on the other, are loaded on to platens extending from the conveyor chains. When they have completed their travel upwards and downwards, the components are discharged on to the horizontal transfer shuttle which delivers them to the wrapping machine *N*.

Waxed paper is fed into the wrapping machine from rolls at one side, one of these rolls being indicated at *P*. A length of paper is cut off from each supply, and an outer race is placed by transfer fingers on one piece, and an inner race assembly on the other. The paper is then wrapped round the two components, and the wrapped inner race is picked up and deposited in the wrapped outer race.

If the bearings are to be supplied direct to another Soviet plant in bulk—as are the bearings in Fig. 17—the wrapped sets of components are ejected on to the belt conveyor *R*, whereby they are delivered to the sloping metal tray in the foreground, whence they are packed into crates. Other bearings are packed into individual cartons and at one side of the conveyor *R* there is a carton-making machine. This machine is seen at the right in Fig. 18, and the carton blanks are cut from thin cardboard, which is supplied in pre-printed rolls.

A pair of wrapped bearing components is picked up from the discharge station of the wrapping machine and is placed on the carton blank, which is then folded round the bearing components to form a box, and sealed. The boxed bearing is deposited on the belt conveyor *R*, which carries it to the crating station.

ASSEMBLY ARRANGEMENTS FOR BALL BEARINGS

Automatic inspection machines, similar to those described, are provided for checking the inner and outer races of ball bearings. From these machines, the races are delivered by separate conveyors to an automatic assembly installation comprising a number of connected machines. The first machine is shown in Fig. 19, and the gravity-feed zig-zag chute for the delivery of outer races is indicated at *S*. One race at a time is released by an escapement mechanism at the end of this chute, and passes down a curved extension, at the end of which it is tilted through 90 deg., so that it enters the guide channel *T* of the machine on its side face. It is thrust along the channel by a mechanically operated ram until it reaches a position beneath the gauging head *U*. This head is mounted on the bottom of a vertical ram, and it is moved downwards to engage the bore of the race, and measure the track diameter by means of expanding probes.

At the other side of the machine, there are similar arrangements for delivering inner races, and the gauging head *V* measures the diameter of the track. Signals corresponding to the measurements thus obtained are fed into the electronic control equipment of the machine, and the appropriate diameter of ball to give the desired

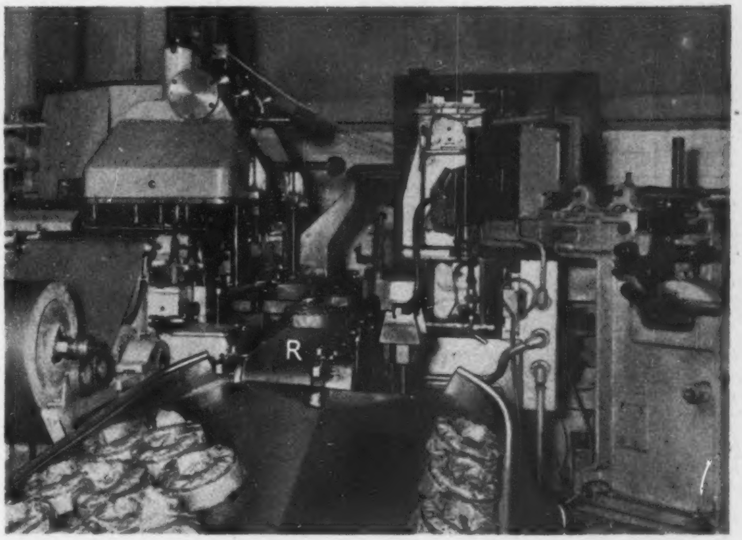


Fig. 18. Another view of the wrapping equipment for bearings, showing the carton-making machine at one side. This machine is used for packing bearings that are not to be supplied in bulk to another Soviet plant

running conditions is determined. A signal corresponding to this ball-diameter is fed to the control equipment of a large ball storage unit at one side of the assembly installation, and the correct number of balls of the required size is delivered from the storage unit to the ball insertion stage of the assembly installation.

The outer race is next transferred from the measuring station to a position in line with the discharge conveyor *W*. It may be observed from Fig. 19 that the guide channel for the inner races is at a higher level than that for the outer races. In consequence, when the inner race is advanced from the gauging position, it drops off the end of the channel into the outer race, already stationed below. The pair of races is then thrust into the conveyor *W*, whereby they are carried to the next stage. If there should not be any balls in the storage unit of the required size for the pair of races that has just been measured, an indicator lamp on the panel *X* is extinguished, and the pair of races is ejected from the discharge conveyor *W* into the chute *Y*, whereby they are delivered to a work-pan.

Fig. 20 shows the second unit of the assembly installation, with one of the covers raised. Pairs of inner and outer races are delivered by the conveyor *W*, Fig. 19, to a flat slideway, along which they are traversed by the shuttle bar *A*, Fig. 20. This shuttle bar has fingers extending over the slideway, and disposed in sets of two, and the bar is arranged to move longitudinally, also to turn through 90 deg., so that the fingers engage the pairs of races; advance them from one station to the next; swing clear at the end of this movement; and then return to their original longitudinal position.

The delivery tube from the ball storage unit is

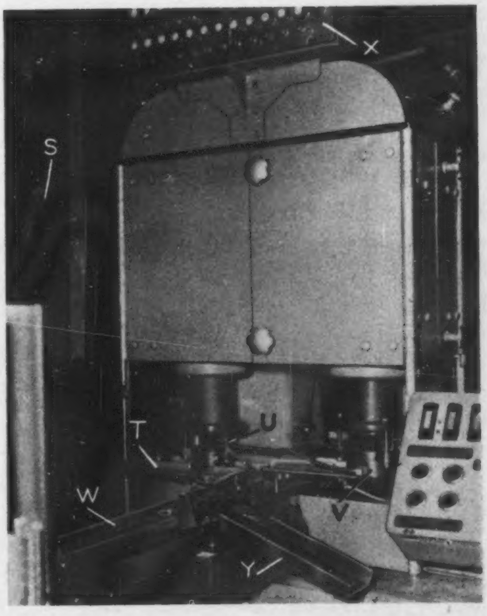


Fig. 19. The first machine in the group for the assembly of ball bearings. From separate inspection machines, inner and outer races are fed by conveyors and chutes to stations where the diameters of their race tracks are measured before they are assembled

indicated at *B* in Fig. 20, and the required balls are delivered to the loading position beneath the ram *C*. This ram carries an inserting head, incorporating a stop to retain the balls, and is moved downwards so that the head makes contact with each pair of races after they have been transferred to this station. Then, the balls are released, and pass out of the head into the space between the two races. At the next cycle of the unit, the races and balls are transferred to an adjacent station, beneath the ram *D*, where a half-cage is assembled. Half-cages are delivered from the press shop of the main plant and are loaded into the magazine chutes on the indexing table of the storage unit *E*. A swinging arm *F*, with mechanically operated gripper fingers, extracts a half-cage from the bottom of the stack immediately adjacent to the transfer ways and locates it over the race assembly, and it is thrust downwards into position by the ram *D*.

At the end of the next transfer movement, the race assembly is stationed beneath a probe, which checks that the half-cage is in place, and ejects faulty assemblies into a work-pan . The next station is beneath the overhead transfer unit *G*, which can be indexed by means of a Geneva mechanism. This unit incorporates a cruciform hub, from which extend four work supports. Each work support is free to rotate in the hub, and has a flange at its inner end with a rubber " tyre." At its outer end there are two claws, which can be swung outwards by a linkage within the hub and work support. The transfer unit is indexed through 90-deg. increments, and, between movements, its work supports are horizontal or vertical. Immediately beneath the transfer ways, in line with the vertical supports, there is a ram, whereby the partly assembled ball bearing at this station can be raised, so that it engages the work support and the bore of the inner race embraces the claws of the support. The claws are expanded to hold the bearing on the support, and the ram is lowered. Then, the transfer unit is indexed through 90 deg. to move the bearing clear of the transfer ways, and into a position opposite to that occupied by the bearing *H*. Here, it is engaged by a gauging probe, and drive is imparted to the work carrier by means of the rubber " tyre," while a running check is performed. After this check, the bearing is swung through further 90 deg. increments during successive machine cycles until it is positioned above the transfer ways. During the last stage of this movement, the work support passes between two hook-shaped guide members at the front of the transfer ways. These members engage flat faces on the support to restore the latter to its original angular setting, in readiness for picking up the next bearing. With the checked bearing positioned above the transfer ways, the claws of the support are moved inwards to release the bearing, and to ensure that it is freed from the work carrier, it is thrust downwards by a pair of fingers on a shaft at the rear of the transfer ways. Bearings that do not pass the running check are ejected by way of a chute and are directed into a work-pan at the rear of the machine.

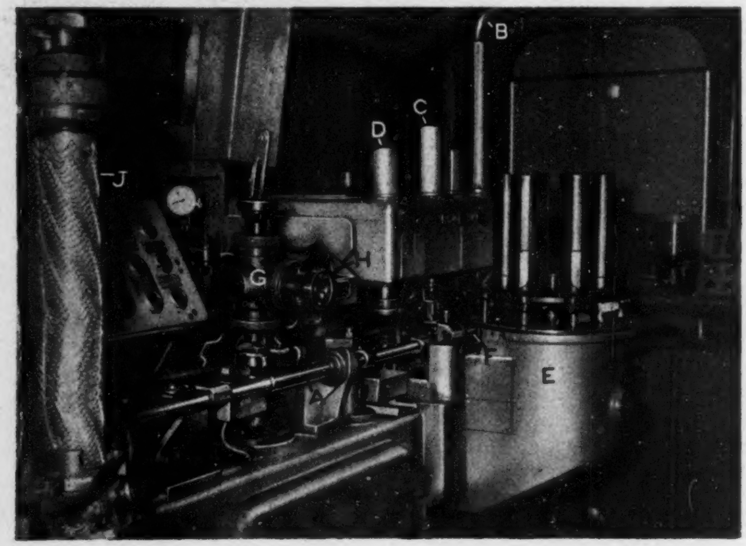


Fig. 20. These units in the group for the assembly of ball bearings provide for delivering one half-cage, inserting the balls (of a size controlled by the measurements made at the previous stage), checking the running fit, delivering the other half-cage, and securing the two half-cages together

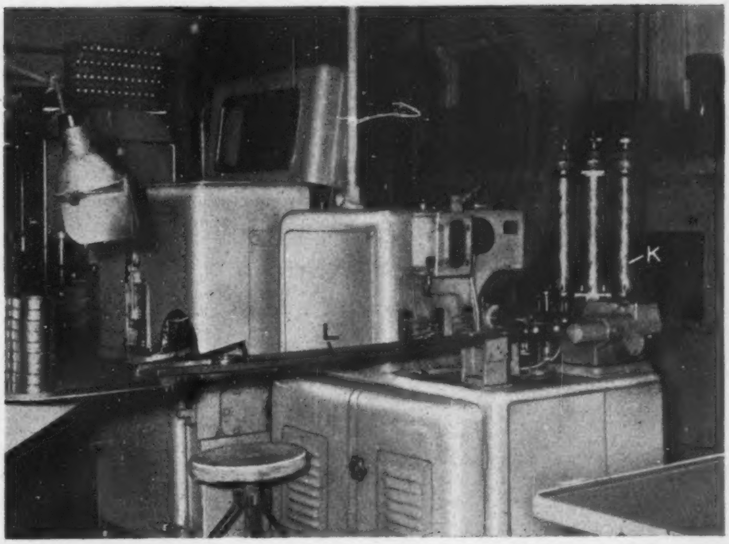


Fig. 21. The ball bearing assembly installation from the rear, with the ball storage unit in the background. Assembled bearings pass along a chute from the last station of the assembly line to a visual inspection station, and thence to a final automatic inspection machine

An idle station follows, and the bearing is then delivered to a station which provides for the assembly of the other half-cage. Both cages are of the usual pressed type, with arcuate portions connected by flat bridge pieces. The lower half-cage has a tag projecting axially from each bridge piece, and these tags are clinched over the bridge pieces of the upper half-pressing, to form the complete cage, and the use of rivets is thus avoided. Lower cages are stacked in magazines on an indexing base at the side of the assembly machine, one stack being indicated at *J*. A swinging arm removes a cage from the bottom of the stack nearest to the transfer ways of the machine, and places it in a nest between the ways, before the partly-assembled bearing is delivered to this position. Provisions are made for aligning the bearing, upper cage and lower cage correctly, before a ram above the work station is moved downwards to clinch over the tags.

Fig. 21 is a view of the ball bearing assembly line from the rear, and the storage unit for balls may be seen in the background to the right. In the left background is the assembly and checking unit for inner and outer races, with the indicator panel associated with the ball store above it. The multi-stack magazine for the lower races is indicated at *K*. Completely assembled bearings are transferred from the final work station to a position in line with the chute *L*, along which they are thrust by a mechanically-operated pusher. At the end of this chute they are visually examined, and are then loaded into the entry end of the shuttle conveyor of an automatic inspection machine, whereby the final checks are performed. From this machine they are conveyed into the neighbouring department, were they are automatically wrapped and packed by means of equipment of a type similar to that already described in connection with taper roller bearings.

Further articles in this series on Soviet industry will be concerned with motor vehicle, turbine and electrical factories in Moscow and Leningrad, and will be published shortly in MACHINERY.

BICC POLYPOLE CABLE AND COUPLERS—A mobile colour television unit has been made by Marconi's Wireless Telegraph Co., Ltd., for Smith, Kline & French Laboratories, Ltd., for demonstrating surgical and medical procedures. Employing Marconi 3-tube image orthicon type cameras, the equipment incorporates 88-way multi-core cable manufactured by British Insulated Callender's Cables, Ltd., 21 Bloomsbury Street, London, W.C.1.

This cable is polythene insulated, and consists of a core of 12 screened single conductors around which are arranged two multiple units of 10 single conductors and five individually-insulated coaxial units. Around these units, there are a further 45 conductors, and the whole is overlaid with a tinned copper braid and a P.V.C. sheath. Each cable is terminated by a BICC moulded-on polypole mark 3D coupler, which may be connected either to the appropriate panel-mounted unit, or to another coupler of similar design. BICC cables and couplers are also suitable for remote control equipment, U.H.F. links, coal mining gear, and industrial television cameras.

Production of Very Accurate Components for Electro-mechanical Control Equipment

Electro-mechanical equipment for a variety of purposes, including the automatic control of aircraft, missiles, armament, and machine tools, are made by the Autonetics division of North American Aviation, Inc., at various factories in California, U.S.A., in which more than 2,100 people are employed in the manufacturing sections. In this article reference is made to some of the operations carried out in the Compton factory.

Optical lead-screws for navigation systems are made with a 52-deg. thread angle and 40 t.p.i. The threads are undercut at the root 0·004 in. wide by 0·006 in. deep to facilitate lapping at the final production stages. Total error in the 7-in. thread length must not exceed 12 micro-inches, and the same limit is specified for "drunkenness," or straightness of the thread. These lead-screws have a nominal diameter of ½ in. and are made from SAE 113 steel.

Preliminary operations provide for accurately centring the lead-screw blank and then drilling and boring both ends to receive inserts for piloting centres. Several diameters are then turned and ground on the two ends of the blank, and the long surface to be threaded is ground, after which the threads are rough-ground from the solid on a Reishauer machine. At this stage, the threads are ground within 40 micro-inches, as regards lead and drunkenness, over the entire length. As seen in the close-up view, Fig. 1, the operator follows the progress of thread grinding through a high-powered magnifier. During the grinding operation, the threads are undercut. The lead-screw is then laid on a bench for 24 hours to permit relief of strains.

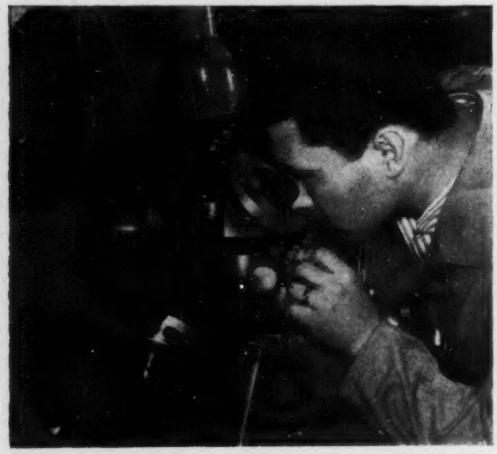


Fig. 1. Grinding the thread of a fine-pitch lead-screw for a navigation system. This screw must be accurate and straight within 12 micro-inches over a length of 7 in.

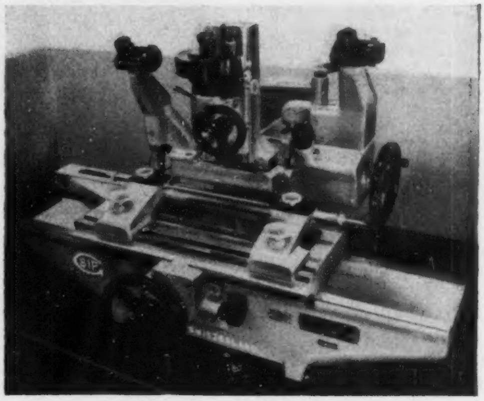


Fig. 2. After both rough- and finish-grinding operations on the thread, various characteristics of the lead-screw are checked on this machine

Next, the screw is thoroughly cleaned by spraying on a solvent, which is subsequently blown off with compressed air. During this process, the operator wears rubber gloves. The thread is then checked for lead error, length of flank, root clearance, centrality of the foot with the flanks, taper of the outside diameter with respect to the axis, and surface finish of the flanks. For all these inspections the Société Genevoise measuring machine shown in Fig. 2 is employed.

When checking the threads for lead error, a goniometric microscope is placed in the machine head. After the lead-screw has been mounted between centres, this microscope is focused on the fourth thread from one end to obtain a zero loca-

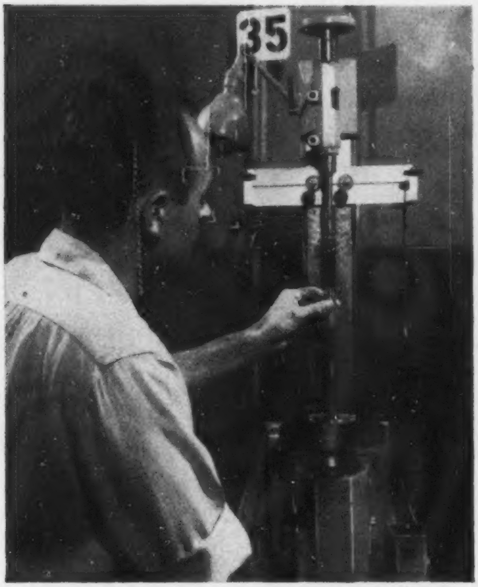


Fig. 3. Extreme accuracy of the lead-screw is obtained by a lapping operation which occupies 12 hours and involves very careful lap manipulation

tion. The lead-screw is then moved in increments of 1·00000 in. to cover the entire length, and recordings are made for each setting. This inspection is made twice to provide a double check for lead error. Thread-root clearance is checked for width and for centrality with the thread form by observing the root over the full length of the lead-screw through the microscope. The other inspections performed in this machine are also carried out with the aid of the microscope.

Subsequently, the threads are finish-ground on the Reishauer machine and are again checked on the Société Genevoise machine. The same inspection procedure is followed, and if there is an error of more than 40 micro-inches per inch of length anywhere along the screw, it is returned to the grinding machine for correction. When the screw has been accepted, it is returned to the temperature-controlled room for accurate grinding operations on the end diameters, and for thread lapping. During the cylindrical grinding operations, the threaded portion of the screw is protected by wrapping it with protective tape. Before lapping, the screw is again carefully cleaned.

Lapping is carried out on the simple vertical machine illustrated in Fig. 3, which provides a means of rotating the screw at a speed of 65 r.p.m. Split brass bushings are first pressed into the ends of the lead-screw to ensure that it will be accurately supported on the centres.

With the lead-screw mounted on the machine, as shown, a small quantity of lapping compound is brushed on the threads, and the halves of a lapping nut are assembled, as seen in Fig. 4. Adjusting rings at the top and bottom of the lapping nuts provide for altering the pressure on the threads to obtain a free running condition. The lapping nuts are made from half-hard brass, and are threaded to suit the lead-screw. Counterbalancing weights attached to the nuts ensure a delicate " feel " in lapping.

Two sets of lapping nuts are used in various combinations to obtain 24 different settings. The lead-screw is lapped for 30 min. with each combination so that the time required to lap one screw is 12 hours. At this operation, the drive to the work-spindle is automatically reversed when the lapping nut reaches the top and bottom of the thread.

At the end of this lapping process, the lead-screw is again cleaned, and a checking nut is then screwed on to the threads. This nut is adjusted to run freely over the entire length of the screw

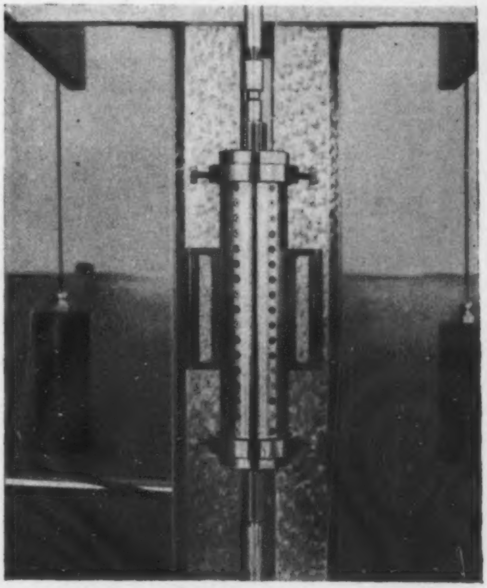


Fig. 4. A close-up view of the adjustable lapping nut. To achieve the high degree of accuracy specified, 24 combinations of half nuts are used

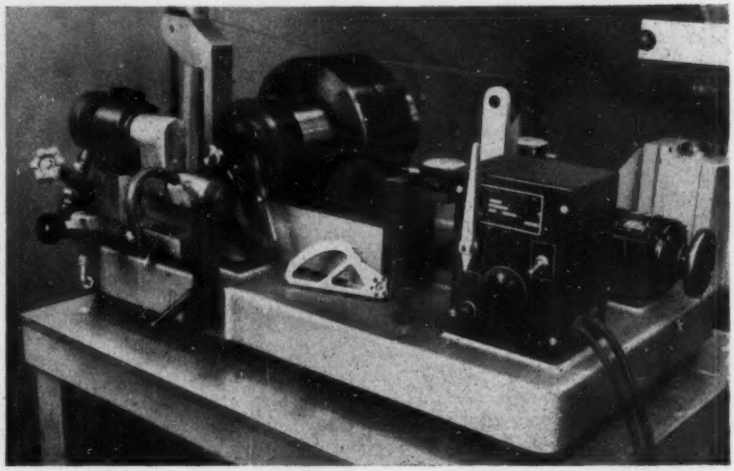


Fig. 6. **Involute cams, such as that seen on the machine base, are produced within an accuracy of 6 micro-inches for profile and with involute error not exceeding 12 micro-inches**

and is manipulated up and down until a smooth-running condition is obtained. After the lead-screw has been removed from the machine, it is thoroughly cleaned, and wrapped in tissue paper until it can be checked with the auto-collimator and accessory equipment shown in Fig. 5. The leads-crew, checking nut, and a mirror, are placed in a holding fixture in approximate alignment with the auto-collimator. The latter is then adjusted so that a light beam is balanced through the amplifier, and readings are then taken on an Esterline-Angus recorder. These readings must not exceed twelve vertical lines over the full length of the screw. The space between each vertical line represents 1 micro-inch.

Another operation which calls for even greater accuracy is the grinding of involute cams of the type seen lying at the front of the machine base in Fig. 6. The actual tolerance on the profile of this cam is only 6 micro-inches, and the allowable error of involute form is 12 micro-inches. Any errors are reduced even further by reason of the close base circle and normalcy tolerances. Cam surfaces must have a finish of 2 micro-inches, r.m.s.

The involute cam is mounted on a shaft which is provided with two base-circle rolls, one at the front and one at the back of the equipment, which run to and fro on flat horizontal bars. The bars and rolls are accurate within 4 micro-inches for profile, and the rolls must be to size within 0·0002 in. and true within 0·00001 in. A small variable-speed servomotor at the right-hand end of the base serves to drive the rolls to and fro on the bars throughout the operation. The large cylindrical member on the roll shaft is connected to counter-weights through wires in order to ensure uniform movement.

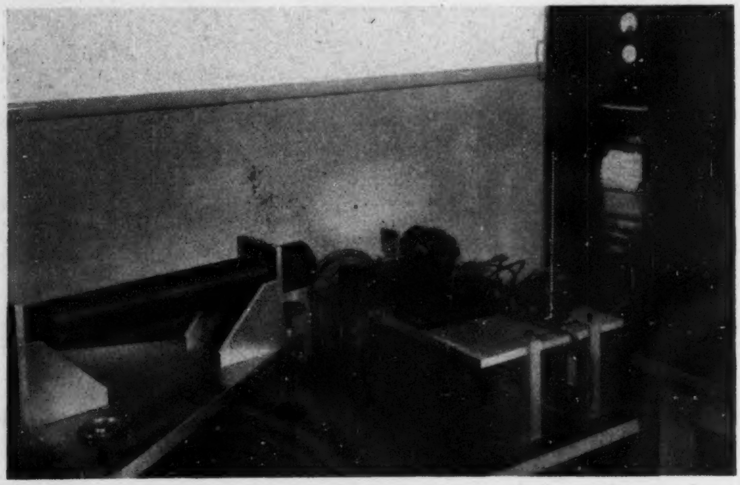


Fig. 5. **The auto-collimator and associated equipment used for the final inspection of the fine-pitch lead-screws for navigation systems**

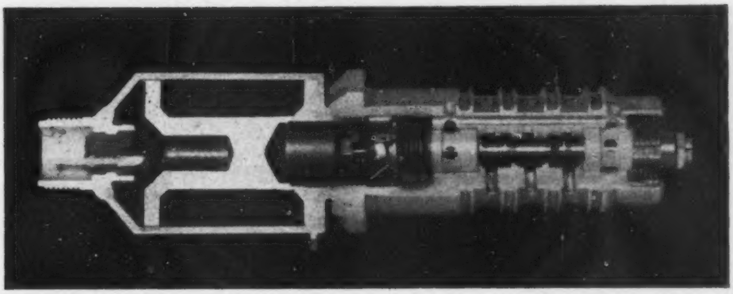


Fig. 7. This 4-way solenoid-operated valve is typical of the precision assemblies required for electro-mechanical devices

At the beginning of the operation, toolmaker's buttons on the two rolls are advanced against dial indicators at the right. By bringing the buttons against these indicators at any time during the grinding process, the operator can determine whether the involute plane has remained the same. Grinding is performed by the face of a 1½-in. diameter wheel on the spindle of an air-driven head at the front of the equipment. This spindle runs at a speed of 16,000 r.p.m. A micrometer provides for fine adjustment of the wheel, and the work surface is moved across the wheel face at the rate of 20 ft. per min. There is a wheel-truing device at the front of the machine.

At the end of the operation, the involute cam is checked on the auto-collimator. Cam profiles have actually been produced which are accurate within less than 4 micro-inches.

Laboratory precision is also specified for a wide variety of parts that are produced on standard machine tools. A typical assembly of such parts is the 4-way solenoid-operated valve shown in Fig. 7. This valve is approximately 6 in. long. One of the parts has a series of lands that operate in conjunction with seats on the valve stem. The lands are machined on the Hardinge chucking lathe in Fig. 8 by means of a multiple-form cutter similar to that seen in line with the work in Fig. 9. The component on the Jones & Lamson turret lathe in this illustration is a pitch-damper housing in which three grooves and adjoining bevelled edges are simultaneously machined by a carbide-tipped cutter. Coolant is supplied to the inside of the part at a pressure of 300 lb. per sq. in.

The pitch-damper housing on the machine in Fig. 9 has four bores, ranging from 0·750 to 1·825 in., which are produced simultaneously with a stepped gun drill. Coolant at a pressure of 300 lb. per sq. in. is supplied during this drilling operation.

In the 4-way valve component there are four lands that must be machined to a width of

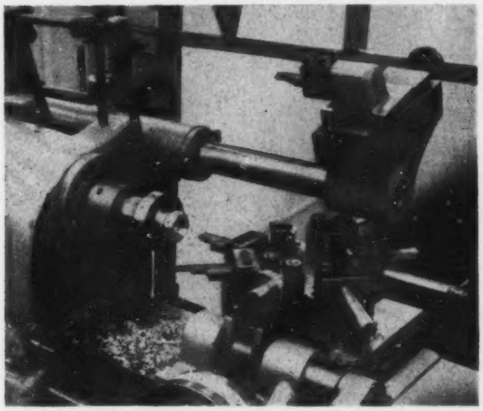


Fig. 8. Machining the lands on a part for a 4-way solenoid-operated valve on a small chucking lathe equipped with a flat turret

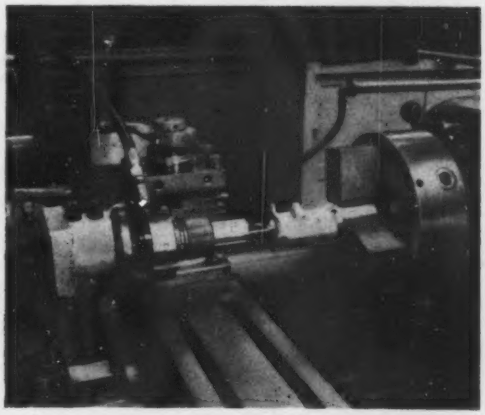


Fig. 9. A multiple-form cutter is employed at this turret lathe set-up for simultaneously machining three internal grooves and adjoining bevelled edges

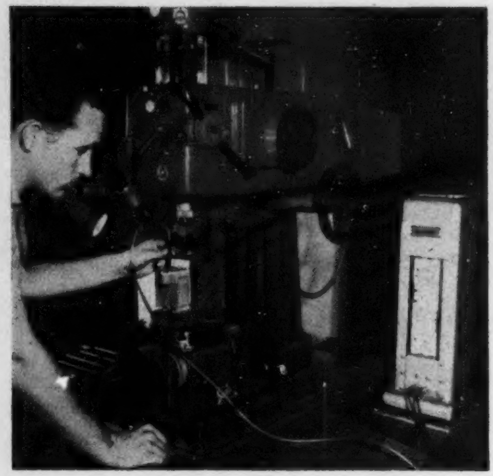


Fig. 10. A Precisionaire gauge is employed to check the diameters of holes machined at this set-up on a Société Genevoise jig borer

0·008 in. and to a finish of 32 micro-inches r.m.s. All the internal cuts on this part are taken on the Hardinge lathe, apart from the drilling of the original hole.

Crush form-grinding is performed on a wide variety of parts on a Sheffield machine. Typical of the work handled is a yaw damper shaft, on which seven different cylindrical surfaces, ten shoulders and three bevels are ground simultaneously at one end, in a time of 8½ min. Later, four cylindrical surfaces, four shoulders, and one bevel are ground on the opposite end in 5 min. Tolerances range from ±0·0005 in. to ±0·001 in.

The Société Genevoise jig boring machine in Fig. 10 is being used for accurate drilling and boring operations on a small aluminium casting that forms a servo gear-case. The limits are only +0·0002 in. minus nothing on hole size and location. Accuracy of the hole is checked by means of a Sheffield Precisionaire gauge.

Other components that must be produced to close tolerances include rocket fuel-pump blades, and gears which may have teeth as fine as 120 D.P. The profiles of such gears are checked by means of a Kodak optical projector.

Combined Drilling and Boring Tool for Template Work

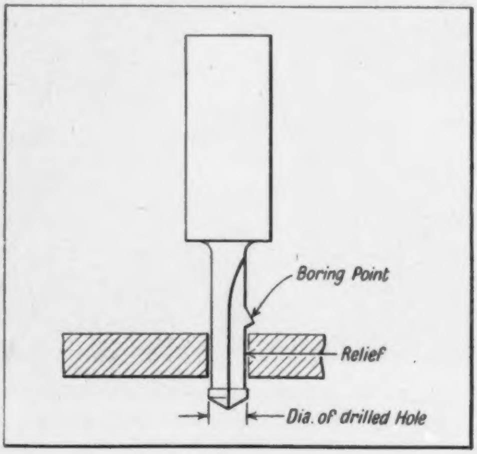
By R. A. STEPHENSON

For producing accurate templates for profile turning, boring, and milling operations, it has been the practice of the National Gas Turbine Establishment, for some time, to drill and bore holes which are located for centre position within close limits. In connection with this work, good results have been obtained with a follow-on drilling and boring tool, as shown in the figure, which is the subject of a patent application (No. 19415/58).

A typical template is $\frac{3}{16}$-in. thick and the leading end of the tool drills a hole from the solid. Behind the drilling portion, the tool is relieved so that it clears the hole. A single boring point is so positioned that it does not come into operation until the drill is clear of the hole. This boring point increases the hole diameter by a few thousandths of an inch and corrects any run-out that may have occurred at the drilling stage.

When the template material is brass or aluminium, the boring point is integral with the tool, but for steel templates, an inserted cemented carbide bit is provided.

The diameter of the template holes is not important, so long as the size is accurately known, because the necessary adjustment can be made by varying the stylus diameter.



Follow-on Drilling and Boring Tool for Accurately Positioned Template Holes

Derota Wire- and Strip-forming Machine

In an earlier article in MACHINERY, 93/719—24/9/58, reference was made to the Derota transfer press, which is produced and marketed by Platarg Manufacturing Co., Ltd., Shortlands, London, W.6. This company has recently introduced the Derota wire-forming machine shown in Figs. 1 and 2, which can also be employed for forming components from strip. The machine has four forming-tool slides, which are disposed as seen in Fig. 2, and can be operated at speeds from 38 to 110 cycles per min. Within this range, it may be noted, the speed is steplessly variable. As will be observed, the mechanism is enclosed in a hinged, pressed-steel housing, in the front of which there is a square aperture that gives access to the working zone.

A rectangular Meehanite plate is mounted vertically on integrally-cast webbed support-brackets, whereby it is attached to the fabricated box-type base. This base houses the ½-h.p. driving motor which incorporates a Sextet variable speed unit, supplied by Industrial Drives, Ltd. Also cast integrally with the plate, there is a series of bosses, which serve to carry a set of four 1-in. diameter silver steel camshafts. The latter run in bronze bearings, and are arranged parallel with the edges of the plate. Drive is transmitted from the variable-speed unit to a worm reduction gearbox through a single V-belt, and thence to the lower camshaft through a Renold duplex chain and sprockets. From this shaft, the remainder are driven through bevel gearing.

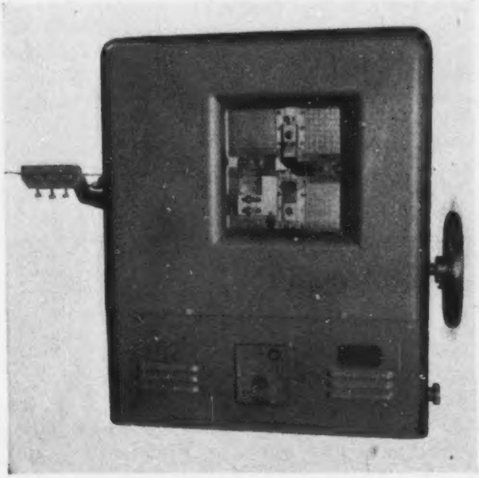


Fig. 1. The Derota wire- and strip-forming machine

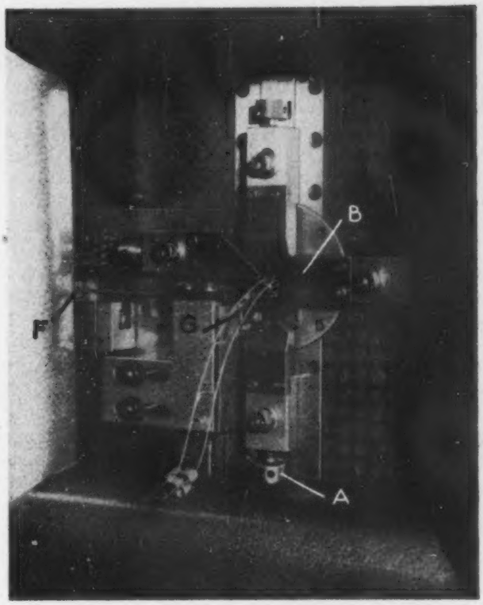


Fig. 2. Close-up view of the working zone, showing the arrangement of the tool slides

The form-tool slides, which move in ways machined in the face of the plate, are actuated by cams, mounted on the shafts, through roller followers, the rollers being held in contact with the cam profiles by return springs. Each tool-holder block is attached to its slide by a single socket-head screw, which passes through a slot, and accurate longitudinal adjustment of the block, for setting purposes, is obtained by means of another screw. As seen at A in Fig. 2, the head of this second screw engages a recess in the slide, and is drilled radially to receive a tommy-bar.

Each tool, *B*, is secured to its holder by two socket-head screws, and may be readily changed.

The cams, of hardened tool steel, are of the adjustable type seen in Fig 3. A collar with a serrated face is pinned to the shaft, and a correspondingly serrated face on the cam assembly is clamped against it by a ring-nut (not visible). There are 40 serrations on each mating face, and the cam assembly is therefore angularly adjustable by 9-deg. increments. In addition, the advance dwell is adjustable from 60 deg. to 120 deg., by means of the lobe extension *C*, which is pivoted on a boss machined integrally with the cam *D*, and can be locked by the screw *E*.

Additional cams on the same shafts control the reciprocating movements of the grip-feed carriage *F*, Fig. 2, the opening and closing of the jaws, the operation of a gripper for holding the stock stationary during the return stroke, and the movements of a stock cutting blade at *G* and a stripper plate. Adjustable stops are provided which limit the movements of the feed carriage in both directions.

In Figs. 1 and 2, the machine is set-up for producing the component shown in Fig. 4, from brass wire of 0·075 in. diameter, at a rate of 110 per min. Fig. 4 also shows the tools, and the disposition of the pins round which the wire is formed. The stock passes through the straightening rolls seen in Fig. 1, and when the feed-carriage has completed its forward stroke, the independent gripper is brought into operation to hold the wire, and the projecting portion is cut off to the required length by the blade *G*.

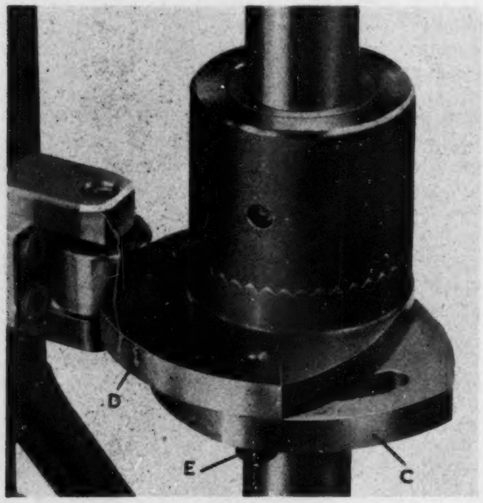


Fig. 3. The cams for operating the tool slides are of the adjustable type, here shown, and provide for an advance dwell of 60 to 120 deg.

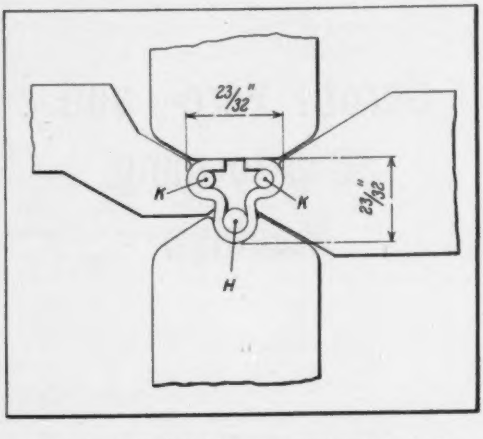


Fig. 4. A typical wire component and the tools employed for its production

The cutter slide moves upwards slightly in advance of the bottom vertical tool-slide, so that the cut-off length is immediately carried upwards and bent round the pin *H*, Fig. 4, to the form of a straight-sided, radiused vee. Next, the two horizontal tools are advanced, to complete the forming of the work round the pin *H*, and to bend the ends round the two smaller pins *K*. Finally, the ends are flattened, as shown, by the upper vertical tool. The tools then return to the starting positions, and the component is stripped from the pins. Mounted on the rear of the Meehanite plate, the stripper carries the pins (or forming mandrel) which pass through holes in the circular cover-plate seen in Fig 2. During the forming stages, the pins are held in the advanced position, and at the end of the cycle the stripper plate is released and retracted by a compression spring, so that the pins are withdrawn and the component falls clear. For the set-up described, wires soldered to the outer ends of the pins *K* serve as guide-rails, so that the parts are delivered at the front of the unit.

Commercial Motor Vehicles, rated at less than 15-cwt. carrying capacity, produced during the second quarter of this year reached a total of 42,455, of which 13,425 were produced for export. Corresponding figures for the same period last year were 36,135 and 12,051, respectively.

S.B.A.C. Static Exhibition—2

In an earlier article in MACHINERY, 93/832—8/10/58, attention was drawn to some of the items on view at the S.B.A.C. Static Exhibition, recently staged at the Royal Aircraft Establishment, Farnborough, and other exhibits are here considered.

PLASTICS AND ASSOCIATED PRODUCTS

Continued development in the plastics and allied fields, and a steady growth in the range of applications of these materials, were again apparent. Aeroplastics, Ltd., Earl Haig Road, Hillington, Glasgow, S.W.2, a subsidiary of The Fairey Aviation Co., Ltd., introduced a new range of pre-impregnated reinforced materials, hitherto only available in the U.S.A. The range covers all normal types of laminating resins, including the polyesters, epoxies, silicones and phenolics, and reinforcements such as glass, nylon, orlon and terylene. Pre-impregnation enables reinforced plastics materials to be employed in the same way as standard laminating materials, and allows them to be bought and stored in continuous lengths, until required. The necessity for preparing resins, catalysts, and accelerators separately is eliminated, with a consequent reduction in wastage, and production time. Curing is effected by conventional methods, at pressures of 10 to 200 lb. per sq. in., and temperatures of 200 to 280 deg. F. The shelf life exceeds 6 months.

Kenilworth Manufacturing Co., Ltd., Hermetite Works, West Drayton, Middlesex, showed a complete range of tooling plastics known as Double Bond Toolform. Hermetal Double Bond filled epoxide resin, a product of the same company, was described in MACHINERY, 93/413—20/8/58. D.B. Toolform is the result of continued development in this field, and provides a complete tooling "system," which is described in detail in literature issued by the company. The basis of the system is a series of eight different compositions, each of which is designed for specific applications.

To facilitate identification, mixing and control, each grade is of a distinctive colour, which appears when the two ingredients employed in its preparation are mixed. These ingredients are packed separately, in the correct proportions for mixing, and are available in packs for preparing quantities of ½ lb. to 20 lb. The various grades include the following. GC Blue is a thixotropic paste, which can be applied to vertical surfaces in thicknesses up to ⅛ in., without "running." This material is intended for brushing on as a facing coat, for use with casting and laminating grades, and can also be used for casting in thicknesses up to ½ in. SS Lilac is for castings ½ in. to 1½ in. thick, and is used with or without GC Blue.

Thicker castings, from 1½ in. to 5 in., are prepared from CM Buff, which can also be employed in conjunction with GC Blue, and LM White is suitable for laminating with woven glass cloth. Grades VF Sage Green and VFC Grey Green are suitable for vacuum forming moulds, and DHP Red and DHD Green are special grades for facing drop hammer punches and dies respectively. With either of the latter materials, CM Buff may be employed as a backing material. It is claimed that all the above materials have exceptional bonding properties, and that metal inserts, such as drill bushes, can readily be incorporated. Exhibits on the stand included a core-box with a body of CM Buff backing, and a top portion of SS Lilac, both with a facing of GC Blue. Another example was a pantograph model, of SS Lilac and GC Blue. A large aircraft drilling jig constructed from Hermetal Double Bond putty, which was also displayed, was described and illustrated in the article mentioned above.

The stand of CIBA (A.R.L.), Ltd., Duxford, Cambridge—formerly Aero Research, Ltd.—was concerned with typical applications of Redux bonding, Aeroweb metal honeycomb, and Araldite epoxy resins. Several examples of the metal honeycomb were exhibited. A recent development by the company is Hidux, an adhesive for metal aircraft structures, which is capable of withstanding elevated temperatures. This development is claimed to be of particular importance, since the temperatures that an adhesive is called upon to withstand in supersonic flight are considerably higher than those encountered at subsonic speeds. Some of the methods employed in producing honeycomb-cored panels were described in MACHINERY, 89/911—19/10/56, and 91/642—13/9/57.

Examples of honeycomb panels constructed entirely from resin-impregnated glass cloth were exhibited by Microcell, Ltd., Imperial Buildings, Kingsway, London, W.C.2, who are manufacturing this material in association with the Hexcel Corporation, U.S.A. The former company, it may be noted, have carried out extensive development work in connection with the production of radomes in void-free glass fibre reinforced plastics material.

In an airborne radar system, the radome serves virtually as a lens, and even microscopic voids can seriously affect performance. For the same reason, dimensional accuracy is important. A conical radome for a supersonic aircraft, in void-free material, which was on view, was stated to have a general accuracy within ±0·004 in. Additional advantages of the void-free material are improved strength, and increased resistance to rain erosion at high speeds. One branch of research being conducted by the company is concerned with the development of resins capable of withstanding, continuously, temperatures of 400 to 500 deg. C.

Another interesting exhibit in the field of inorganic heat-resisting fibrous material was that of The British Refrasil Co., Ltd., Stillington, Co. Durham, whose product Refrasil is a light-weight fibrous silica, which can be subjected to temperatures up to 1,000 deg. C., continuously. This material, which has exceptional thermal insulating properties at high temperatures, is also an efficient high-temperature electrical insulator, and is resistant to thermal shock and acid attack. Available in the form of " batt," bulk fibre, yarn, tape, cloth, sleeving and cordage, which are generally similar in appearance to corresponding glass fibre products, the material has numerous industrial applications. " Batt," it may be noted, is the term used to denote a felt-like form, with random orientation of the interlocked fibres.

A typical application of the material in the gas turbine field is for heat insulating blankets, and for this purpose, the batt is usually enclosed in Refrasil cloth, or stainless steel or other heat-resisting metal foil. This foil, which is 0·003 in. to 0·004 in. thick, is dimpled or corrugated for strength, and is seam-welded at the edges. Panels of this type can readily be formed to suit the contours of the component to be insulated, and are employed in situations where it is necessary to prevent fuel from reaching the insulation. Some representative examples of panels of this type were exhibited, and are shown in Fig. 1, in which may also be seen some thin-walled, spirally-corrugated tubes. Such tubes are employed for retaining the insulating material on pipework, and are assembled by screwing them into position. Also displayed were examples of welded honeycomb, in light-gauge stainless steel.

RUBBER DEVELOPMENTS

Continued progress in the field of elastomeric engineering materials was also evident, and a number of firms exhibited new products of this type. Precision Rubbers, Ltd., Station Road, Bagworth, Leicester, showed typical examples from their wide range of O-rings, mouldings and extrusions, in natural, synthetic, and silicone rubbers. They also featured their extensive, recently-developed range of Prescolastik silicone rubbers. New forms in which these materials are available include foam rubber, and rubber-coated fabrics. Prescolastik foam rubber is of low density, and is resilient over a temperature range of −70 deg. C., to 200 deg. C. Sample components, made from compounds based on the new fluoro-rubber, Viton A, indicated the possibility of employing elastomeric materials in contact with fuels, oils and chemicals, at temperatures of 250 to 300 deg. C.

The display by British Insulated Callender's Cables, Ltd., 21 Bloomsbury Street, London, W.C.1, was concerned with products suitable for application in the guided missile field.

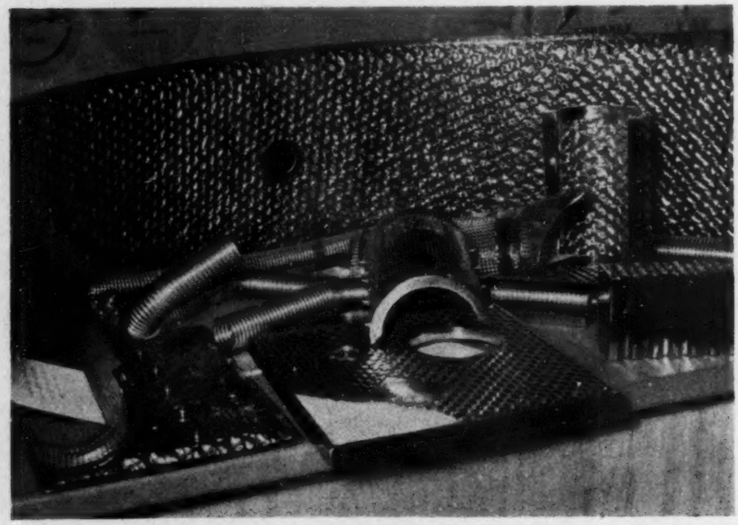


Fig. 1. These lightweight high-temperature insulation panels, made by the British Refrasil Co., Ltd., are based on silica fibre

These products included their Uni-efglas cables and P.T.F.E. equipment wires, designed for continuous operation at temperatures up to 240 deg. C. and 250 deg. C., respectively. A new development is a range of sub-miniature coaxial cables, with overall diameters of less than 0·10 in., and one typical example had an inner conductor of silver plated, copper coated steel wire, of 0·0124 in. diameter, insulated with solid polythene. The latter was braided with plain copper wire, and sheathed in nylon, and the overall diameter was only 0·068 in. These small cables are designed for use in miniaturized electronic equipment. Other exhibits included P.T.F.E. multi-core cable, and Tersil aircraft wiring cable. With a normal temperature operating range of −55 deg. C. to 190 deg. C., the latter can withstand direct exposure to flame, at 1,100 deg. C., for 5 min.

Dowty Seals, Ltd., Ashchurch, Tewkesbury, Glos., also showed examples of specially developed high- and low-temperature synthetic rubbers, and rubber compounds for use with mineral oils, hydraulic fluids, and iso-propyl nitrate. This group included high tensile silicone rubbers, and special silicone elastomers, for use with carbon dioxide at high temperatures. Reference may also be made to a fluoro-silicone rubber, for use with gas turbine fuels, high aromatics, and certain solvents. Four new types of seals were on view, comprising an all-metal design, boss seals, flange seals, and Selons. The all-metal seal is for retaining high pressure oils and gases in conditions beyond the capacity of elastomeric materials, and can be used at temperatures from −65 deg. C. to more than 250 deg. C. Boss seals are interchangeable with O-rings in American Standard pipe connections, and have been tested at pressures up to 10,000 lb. per sq. in., and over a temperature range of −65 deg. C. to 250 deg. C. The flange seal is for pipe flanges and similar fittings, and comprises a metal spacer with synthetic rubber sealing lips. Selons are captive sealing washers in nylon, for low-pressure duties.

HYDRAULIC EQUIPMENT

Among the exhibits of Dowty Equipment, Ltd., Arle Court, Cheltenham, Glos., was a sectioned Perspex model of a 4-way electro-hydraulic servo-valve, which they are producing under licence from the Moog Valve Company Inc., U.S.A. This valve is used extensively on American missiles and aircraft, and has exceptional hysteresis and resolution characteristics. The hysteresis is less than 5 per cent, and the resolution less than 2 per cent of the rated current over the full working range. The same company showed typical undercarriages for several aircraft in current production, and Dowty Nucleonics, Ltd., Brockhampton Park, Andoversford, Glos., exhibited examples of switches, including a new silicone grease-filled type, designed to obviate freezing-up at high altitudes.

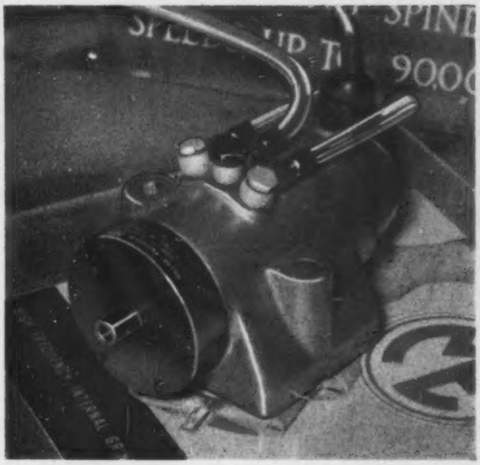


Fig. 2. Representative example of a Mollart high-frequency internal grinding spindle

The hydraulics division of The Fairey Aviation Co., Ltd., Hayes, Middlesex, displayed representative examples of power controls for aircraft, and the Fairey electro-hydraulic servo-valve. This valve has already been employed successfully in a wide range of applications, including the control of machine tools and a strip rolling mill, and the automatic positioning of optically-projected images. Operated by an integrally-mounted electro-mechanical torque motor, the valve provides for the accurate control of hydraulic flow, related to input current, and has been used with systems operating at pressures up to 4,000 lb. per sq. in. Single-stage units are available for maximum output flow of 1·8 gall. per min., and by employing a two-stage system, incorporating another valve of higher capacity, almost any desired flow can be obtained. Two-stage units are in production which have a capacity for handling 30 gall. per min., at 5,000 lb. per sq. in.

HIGH-SPEED INTERNAL GRINDING SPINDLES

An example from their range of high-frequency, high-speed internal grinding spindles, which was exhibited by the Mollart Engineering Co., Ltd., Kingston By-pass, Surbiton, Surrey, is shown in Fig. 2. Designed to operate at speeds up to 90,000 r.p.m., for grinding small bores, these units are available with solid or removable quills. The solid-quill units are known as type 1, and the removable-quill units as type 2. Each type is available in five capacities, with quill diameters of 0·750 in. to 0·420 in. The 0·750-in. unit is designed to run at speeds of 20,000 to 36,000 r.p.m., and the 0·420-in. unit at 80,000 to 90,000 r.p.m. With one exception, these spindle units can be supplied with alternative pilot-diameters, for mounting purposes. The overall range of pilot diameters is 3⅜ in. to 6⅜ in.

Carried in roller-type bearings, the spindles of these units are oil mist lubricated, and the stators are jacketed for liquid cooling—usually by means of the machine coolant supply. High-frequency alternating current is supplied by an inductor/alternator unit, which can be arranged to supply a number of spindles operating under similar conditions, if required. Variable-speed spindles of this type are also available, for use with a frequency controller. An air supply of 1 cu. ft. per min., at 10 lb. per sq. in., is required for the oil mist lubricating system.

RECIRCULATING BALL SCREWS

Armstrong Siddeley Motors, Ltd., Parkside, Coventry, drew attention to the range of ASM Beaver recirculating ball screws and splines, which they are producing in this country by agreement with Beaver Precision Products Inc., Detroit, U.S.A. These units are available in a wide variety of types and sizes, and have numerous uses in the aircraft and missile fields, as linear transducers. In addition, they can be applied to various types of industrial equipment, including machine tools. Characterized by low friction, freedom from backlash, and high overall efficiency, they can also be employed reversibly, for converting linear motion to rotary motion, and linear position to angular measure.

The various ball nuts include single- and multiple-circuit types, and preloaded nuts are also available. A representative preloaded unit comprises, in effect, two nuts, with a spacer assembled between them, and the arrangement is analogous to the use of two opposed angular contact ball bearings. Preload can be closely controlled by adjusting the thickness of the spacer, and should any significant wear take place, it can readily be compensated by surface-grinding the spacer. It is pointed out that wear is usually negligible, and that ball screws are relatively insensitive to air-borne dirt and grit. They are, moreover, readily sealed against swarf or other harmful foreign matter. Heavy preloads, it may be noted, do not necessitate excessive torque inputs. The pitch diameters of the screws range from $\frac{5}{16}$ in. to 6 in.

WELDING EQUIPMENT

The display by Sciacky Electric Welding Machines, Ltd., Falmouth Road, Trading Estate, Slough, Bucks, included an illuminated diagram which illustrated the 3-phase system employed in their spot-welding machines, whereby the number of current alternations during each welding cycle is accurately controlled. This system, it was pointed out, ensures consistent weld quality, and increased electrode life. Examples were also exhibited of corrugated sandwich construction, in which spot-welds are employed for securing an outer skin to the tops of the corrugations in the reinforcing material. In this type of construction, which is employed extensively by Handley Page, Ltd., for primary structure, the inner skin is usually attached to the corrugations by the blind riveting process.

The company has recently published an enlarged and completely revised fourth edition of their pocket-diary sized "Gen" Book, which contains a considerable amount of useful information on all aspects of resistance welding.

Attention was drawn to their wide range of activities in the field of aeronautical engineering by the exhibits of three member companies of the British Oxygen group. British Oxygen Engineering, Ltd., The Pinnacles, Western Industrial Estate, Harlow, Essex, featured airfield and rocket site equipment in the outdoor section of the exhibition. The exhibits were chiefly concerned with the handling and storage of liquid oxygen, and mobile plant for its conversion into gaseous form. British Oxygen Aro Equipment, Ltd., Bridgewater House, Cleveland Row, London, S.W.1, showed liquefied-gas, pneumatic, and hydraulic valves for aircraft and guided weapons.

The exhibits of British Oxygen Gases, Ltd., Spencer House, St. James's Place, London, S.W.1, served to illustrate developments in welding and cutting in the aircraft industry, and included typical examples of automatic Argonarc welding, and Argonarc spot welding. Also displayed were items of Argonarc welding equipment which can be used for aluminium, magnesium, stainless steel, high tensile steel, mild steel, and titanium, in thicknesses ranging from 0·002 in. to several inches. Oxy-acetylene welding and cutting equipment on view included the Saffire blowpipe, for flame cutting operations.

FASTENING DEVICES

Aviation Developments, Ltd., Kingsbourne House, 229-231 High Holborn, London, W.C.1, who specialize in blind riveting and fastening systems, showed a recently-introduced, patented, high-strength fastener known as the Jo-Bolt. This fastener comprises a hollow steel body—in effect, a nut—in the threaded bore of which is preassembled a high tensile steel bolt carrying a stainless steel sleeve. The bolt head and sleeve are slightly smaller than the body, to enable them, and the latter, to be inserted through the hole in the work. Closure is effected by means of a hand tool, or a portable pneumatic gun, equipped with a driving device that engages a reduced portion of the bolt. This reduced portion projects from the head.

When the driving device is actuated, the bolt is screwed into the body, and the sleeve is forced over a conical portion at the inner end. The sleeve is thereby expanded, and tightly clinched against the inner face of the assembly. At a predetermined load, the reduced portion snaps off, leaving the body plugged by the bolt, so that the fastener becomes virtually solid, as regards shear strength and clinch. These fasteners are available in sizes of $\frac{3}{16}$ in., $\frac{1}{4}$ in., and $\frac{5}{16}$ in. diameter, in countersunk and hexagon-head types, and the former provide for a practically flush exterior.

Among the wide variety of fasteners exhibited by Guest, Keen & Nettlefolds (Midlands), Ltd., Box 24, Heath Street, Birmingham 18, were examples in titanium and nylon. The titanium fasteners produced by the company include a comprehensive range of bolts, nuts, rivets, and cotter pins, and considerable development work has been carried out on forging techniques and finishing processes. Much of this work has been concerned with the attainment of properties equivalent to those of the corresponding steel fasteners, whereby an immediate weight-saving can be effected by substituting the titanium components for steel. It has been estimated that, on one large, typical, civil aircraft, a weight-saving of 500 lb. could be obtained by substituting titanium bolts for steel. In addition to their value to the aircraft industry, titanium fasteners can frequently be used with advantage in the marine and chemical engineering fields, because of their resistance to corrosion.

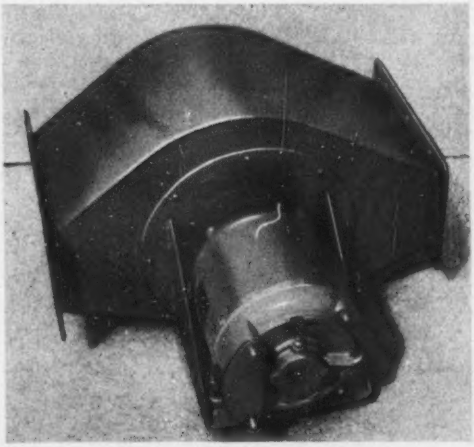


Fig. 3. Bassaire straight-through fume extractor fan made from PVC material, exhibited by British Manufactured Bearings Co., Ltd.

The nylon screws mentioned are available in a variety of types, including round head, raised head, cheese head, and Phillips recessed head, in sizes from 8 B.A. to 0 B.A. For certain special applications, these screws afford a number of advantages, among which may be mentioned high dielectric strength, resistance to chemical attack, and the fact that they are inherently self-locking. The company's range of Wedglok self-locking nuts, bolts, and screws was also featured. Each of these fasteners incorporates a small nylon insert, which projects slightly above the crest of the threads, and exerts a wedging action. Since the nylon is resilient, the fastener can be used after removal.

In addition to examples of their high precision miniature ball bearings, British Manufactured Bearings Co., Ltd., Boscobel, High Street, Crawley, Sussex, exhibited John Bass, Ltd., pressurized and vacuum assembly cabinets, for which they are the sole agents. Two recent additions to this range are the Bassaire fume extractor fan (shown in Fig. 3) and the Bassaire "man cleaner." Constructed entirely from PVC, for corrosion-resistance, the fume extractor is of a straight-through design, designed to save space, with a performance comparable with that of the orthodox centrifugal type.

The "man cleaner" is the subject of a patent application, and is intended for use at the entrance to rooms where assembly work is carried out under conditions of scrupulous cleanliness. The unit forms an intermediate stage between a changing-room and the "clean" room, and serves to remove any loose dust from the operator's special clothing, into which he changes before entering. It comprises two pressurized chambers, in which air is drawn from the outside, filtered, and directed in pulsating jets on to the operator. All dislodged dust is drawn off through an exhaust system, which delivers to atmosphere outside the building. Once he has been "decontaminated," the operator passes on into the adjoining clean room.

Fig. 4. Type 1153 Soniclean ultrasonic cleaning equipment. (Dawe Instruments, Ltd.)

ULTRASONIC EQUIPMENT

Dawe Instruments, Ltd., 99-101 Uxbridge Road, Ealing, London, W.5, demonstrated their type 1153 Soniclean generator, for ultrasonic cleaning, shown in Fig. 4. This unit, which has a high-frequency output of 1 kW to 4 kW, operates at 36 to 40 kilocycles per sec., pulsed at mains frequency, and is suitable for activating up to 20 gallons of solution, for cleaning surfaces with areas up to 340 sq. in. Either eight, six, or four barium titanate transducers are employed, according to the power required, and they may be mounted either in an existing or a specially-constructed tank. The frequency indicated has been selected in order to ensure efficient cleaning, with a minimum of direct and cavitation noise. The unit is suitable for large-scale production cleaning and processing, and soluble oils, for example, can be removed in approximately one minute. Several examples of Dawe ultrasonic equipment were described in MACHINERY, 89/393—17/8/56.

Among new developments by Rotax, Ltd., Willesden Junction, London, N.W.10, was a dry particle magnetic clutch, designed for use in servo and other control systems, in which torque control, smooth operation, and rapid response, are required. Power is transmitted by means of fine magnetic powder, which, when energized, forms a series of bridges between the clutch plates. So long as these bridges are intact, there is no slip, but immediately the current supply to the operating coil is cut off, they collapse, and 100 per cent. slip is thus obtained. The torque at which slips occurs may be accurately controlled by varying the coil current. Units of this type, it is stated, will operate for long periods with very little attention.

HUMIDITY DETECTION

Export Packing Service, Ltd., Imperial Buildings, 56 Kingsway, London, W.C.2, demonstrated a new electrical device designed to protect packaged stores by facilitating the detection of humidity in the incipient stage, before it can cause damage. A sensitive element, fitted in each package, can be utilized in a number of ways. In the simplest application, a portable indicating instrument is employed to carry out checks during periodic inspections. Alternatively, the elements in a number of packages can be coupled to indicating instruments on a centralized control panel, or to recorder-type equipment which maintains continuous records. Provision can also be made for automatic visual or audible warning, when the humidity in a package reaches a dangerous level. The system has been developed by the company in collaboration with E.M.I. Electronics, Ltd., and is being carried to a full production stage on behalf of the M.O.S. Inspectorate of Electrical and Mechanical Engineering Contracts.

MIRROSPEED ELECTRODES—A new range of electrodes, designed for the rapid and economic welding of mild steel, has been introduced by Quasi-Arc, Ltd., Bilston, Staffs. Known as Mirrospeed electrodes, they are suitable for production work where high output and good weld profile are required, since their features include smooth running, a quiet arc, and a fluid but easily-controlled slag which can be readily removed.

The electrodes can be used for welding in all positions, and are particularly suitable for flat and horizontal/vertical fillet welding, also flat butt welding. By using a size that is one gauge larger than normal, longer runs can be made at high speeds, thereby reducing the time required for changing electrodes.

Mirrospeed electrodes are made in sizes ranging from 12 to 4 s.w.g., and are fully extruded and coded under the B.S. 1719:1951 classification as E.217, which corresponds to the AWS/ASTM classification E.6012. They are suitable for use with either A.C. or D.C. supplies, and if D.C. is employed, the electrode can be connected to either pole. Approved by the Lloyds Register of Shipping and the Ministry of Transport and Civil Aviation, Quasi-Arc Mirrospeed electrodes conform to B.S. 639:1952.

New Production Equipment

Craven Duplex Horizontal Boring Machine

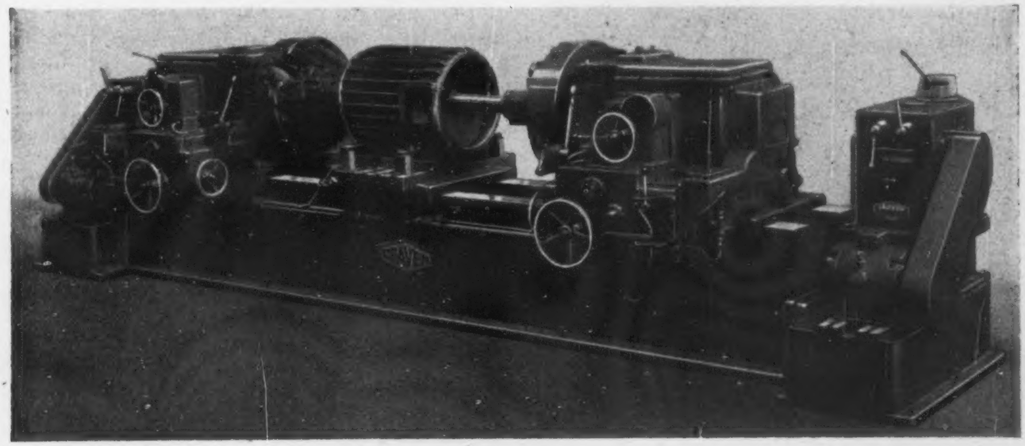
Craven Brothers (Manchester) Ltd., Reddish, Stockport, have recently built the duplex horizontal boring machine, here illustrated, for Lancashire Dynamo & Crypto, Ltd., Trafford Park, Manchester, for boring, facing and grooving operations on stator casings. The work is held stationary upon a central table, while machining operations are carried out on both ends simultaneously by the right- and left-hand heads.

All three machine units are adjustably mounted on a heavy box-type two-shear bed, with square-section slideways, and can be clamped in any desired positions. The table is T-slotted and has a recess to enable the work fixtures to be located and secured. Each headstock is mounted on a wide saddle base and is equipped with a forged steel spindle which runs in bronze cylindrical bearings, the axial load being taken on ball thrust washers.

Spindle speeds for each headstock range from 6 to 120 r.p.m., and the drive is taken from a separate 7-h.p. constant-speed motor and 12-speed gearbox mounted on a baseplate attached to the end of the bed. A keywayed shaft extends from the gearbox into a driving sleeve at the rear of the headstock, and the final transmission is by pinion to a large gear wheel on the spindle. Each spindle is fitted with a 30-in. diameter faceplate, with a long facing slide which has T-slots for the attachment of snout-type boring and facing toolholders. The latter carry interchangeable long or short boring bars to suit the operations to be performed, and facing tools are mounted in the base of each holder.

Reversible power feeds and separate handwheel adjustments are provided for the traverse of each headstock on the bed, and for the movement of the facing slide radially on the faceplate. An additional, extra-fine hand adjustment is obtainable for either feed traverse, to facilitate accurate tool setting. The longitudinal feed motion drive is obtained from the main spindle in the headstock through a 4-change gearbox to a pinion meshing with a rack mounted between the bed ways.

Feed is engaged in either direction by drop-

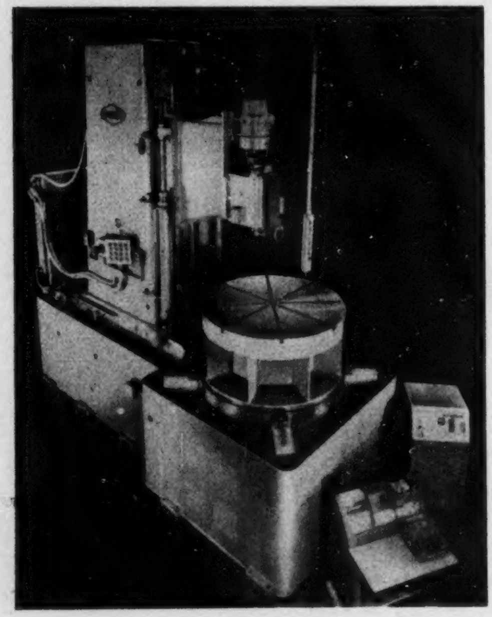


Craven duplex horizontal boring machine for stator castings worm mechanism, and automatic feed trips are provided which are operated by adjustable dead stops on a 5-position gauge bar. Feeds to the facing slide are obtained from the same change-speed gearbox, but are transmitted through differential gearing and a shaft which passes through the spindle to the faceplate, where a rotating screw engages a half-nut beneath the slide. Provision is made for adjusting the nut to take up backlash. Longitudinal feeds for boring range from 0·08 to 0·0133 in. per rev., and facing feeds, from 0·030 to 0·005 in.

The work table is 2 ft. long by 3 ft. 6 in. wide and has hand adjustment on the bed by rack and pinion. Spindle centre height from the top of the table is 15 in., and from the bed, 20 in. Each headstock has a maximum longitudinal traverse of 33 in. on the bed, and the radial traverse of the facing slide is 7 in.

Baker Electronically-controlled Bolt-circle Drilling Machine

The vertical drilling machine shown in the accompanying illustration has been developed by Baker Bros., Inc., Toledo, Ohio, U.S.A., for drilling rings of bolt holes in components for jet engines. The pitch circle diameter of the holes may range from 0 to 60 in., and the machine incorporates an indexing table, controlled from punched cards, whereby a total of 300,000 different angular positions may be obtained. Provision is made for either manual or fully-automatic control.



Baker electronically-controlled bolt-circle drilling machine

The drilling spindle is housed in a saddle which has a hydraulically-operated vertical movement of 30 in. on the welded steel column. Adjustable cams provide an automatic operating cycle of rapid advance, feed, and rapid return for the spindle. Provision is made for adjusting the rate of feed, and the spindle speeds are steplessly variable from 60 to 3,000 r.p.m.

Horizontal adjustment is provided for the column on the bed of the machine so that the centre of the spindle can be set in the desired position relative to the centre of the indexing table, the final setting being obtained by means of measuring rods. This adjustment is powered by an individual electric drive and, when the required radial setting has been obtained, the column is locked to the bed by means of pinch-type clamps.

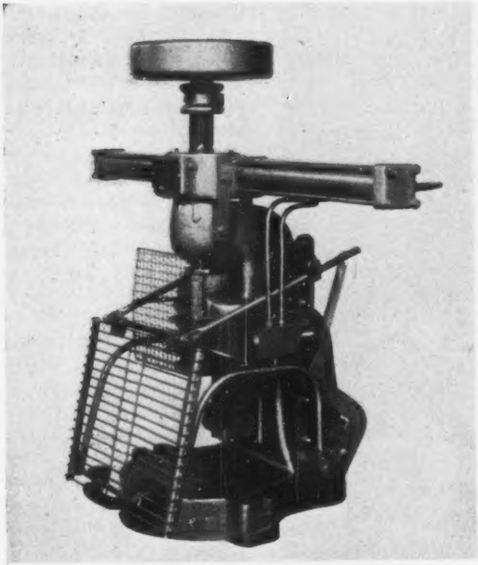
Indexing of the 60-in. diameter work table is controlled automatically by a standard IBM punched-card system, and holes can be positioned within ±0·002 in. at a distance of 24 in. from the centre of rotation. For setting-up, the work is clamped directly to the table and, after the required radial position of the spindle has been set, the first hole is drilled, under manual control. Next, the indexing mechanism is set to zero, and the machine then continues to operate automatically under punched-card control. After each hole has been drilled, the table is rotated initially at a rate of 1·5 r.p.m., and then, when it is within approximately 1 min. of arc from the final position, it is automatically slowed down for final location. There are no indexing plungers in the table mechanism, and hydraulically-operated pinch-type clamps are provided for locking the table during the drilling cycle.

The agents for Baker Bros., Inc., in this country are Wickman, Ltd., Fletchamstead Highway, Coventry.

"Fly-Air" Conversion Unit for a Fly Press

In the figure is shown a fly press fitted with the Fly-Air conversion unit recently introduced by the B.H.P. Machine Tool Co., 91 Wattville Road, Birmingham 21.

This unit comprises, essentially, a pivoted safety guard, and a long-stroke, double-acting, air cylinder and rack and pinion assembly, mounted on top



A fly press fitted with the B.H.P. Fly-Air conversion unit

of the press frame. In operation, when the guard has been swung downwards to its lowest position, an air valve is automatically operated. During the resulting travel of the piston, rack teeth on the piston rod impart rotation to a pinion keyed to the screw of the press so that the ram is moved downwards. Simultaneously with the operation of the air valve, an interlocking mechanism is brought into use which prevents movement of the guard upwards during the working stroke of the ram.

At the end of the downward travel of the ram, a trip rod is operated, the interlocking mechanism is released, and the setting of the air valve is reversed. In consequence, the piston is returned to its original position thereby moving the ram upwards, and, during this travel, the guard can be raised.

The unit enables particularly short cycle times to be obtained, and is stated that forces at least equivalent to those obtained by conventional hand operation of fly presses can be applied to the work. Moreover, air consumption is low.

Colonial-Romulus Tracer-controlled Contour- and Profile-milling Machine

To supplement their range of Dupli-Mill and Hydro-Cycle tracer-controlled milling machines, the Colonial-Romulus Division of the Colonial Broach & Machine Co., Detroit, Michigan, U.S.A., have developed machines of two sizes which enable tracer-controlled contour- and profile-milling operations to be carried out easily and rapidly on a wide range of materials. As may be seen in Fig. 1, the vertical slide is carried on the front of a large vertical column, and the latter houses the feed mechanisms for the vertical and in-and-out movements of the slide and milling spindle. The ways on the front of the column are hardened and ground, and the vertical slide is counterbalanced by a weight.

A hydraulic motor is employed to drive the mill-

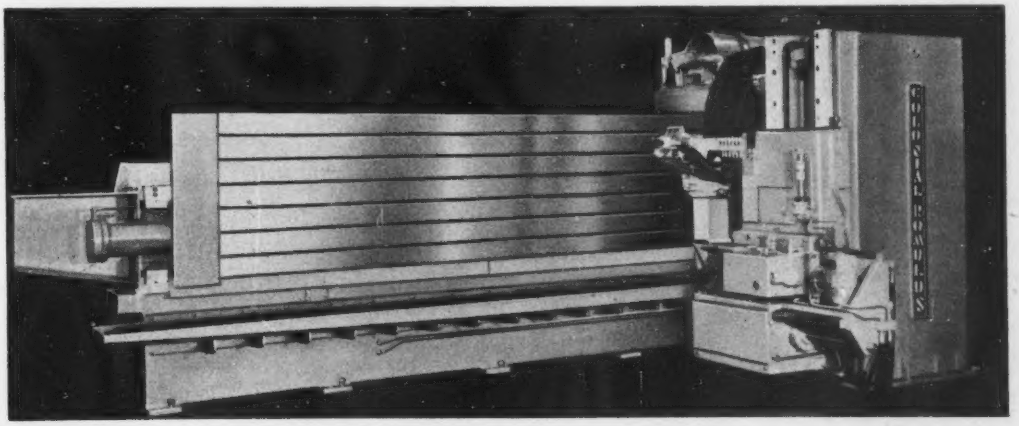


Fig. 1. Colonial-Romulus hydraulically-driven, tracer-controlled, contour- and profile-milling machine

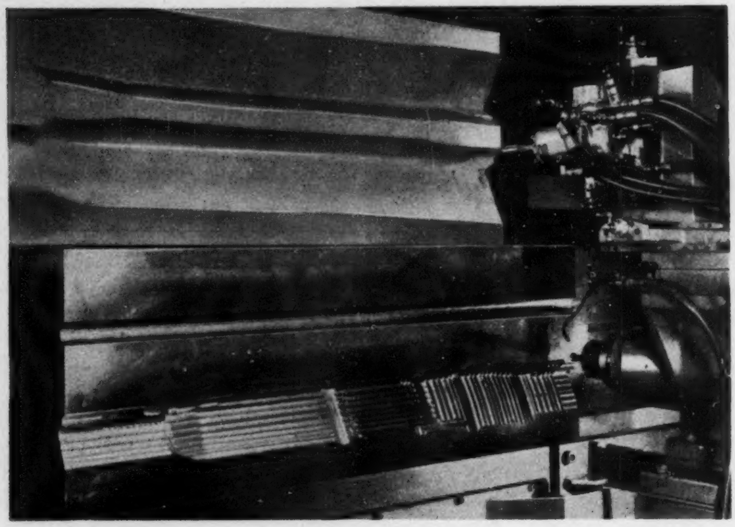


Fig. 2. Close-up view of the machine shown in Fig. 1 set up for machining a forging die from a plaster model

ing spindle, which has steplessly-variable speeds from 36 to 1,900 r.p.m. and is mounted on special anti-friction bearings to ensure the required accuracy at high speeds and to take the thrust exerted by the cutter during low-speed machining. The spindle has a maximum transverse travel of 24 in., and this movement, also the vertical traverse of the spindle slide, can be varied steplessly from ⅛ to 40 in. per min. A similar range of traverse speeds is available for the work-table and template carrier, in the horizontal direction. The base of the machine is of welded steel construction with internal reinforcing ribs to eliminate vibration and distortion.

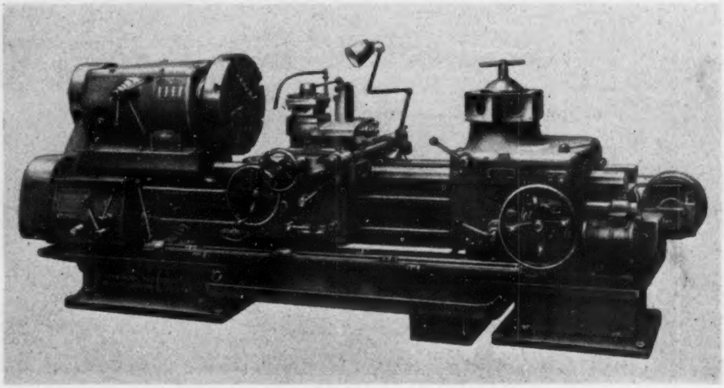
The close-up view, Fig. 2, shows the working area of the 144-in. stroke machine, with a forging die mounted on the work-table. A number of roughing cuts has been taken on this workpiece, the movements of the cutter being controlled by the tracer which engages the plaster model seen mounted on the work-table immediately above the blank. The finish-machining operations are carried out at the same set-up.

Three tracer-control arrangements can be provided, namely, 3-dimensional, 360 deg., with adjustable depth control, and with a power feed in the longitudinal direction. It is stated that these machines, which have 120- and 144-in. strokes, can be employed for machining a wide variety of metals, including the latest temperature-resisting, high-strength alloys, at suitable cutting speeds and feed rates.

Gaston E. Marbiax, Devonshire House, Vicarage Crescent, Battersea, London, S.W.11, are the agents in this country for the Colonial Broach & Machine Co.

Crowthorn 12½-in. Centre, Combination Turret Lathe

The 12½-in. centre, combination turret lathe, here shown, has recently been built by Crowthorn Engineering Co., Ltd., Atlas Works, Reddish, Stockport. Workpieces up to 16¼ in. diameter can



Crowthorn 12½-in. centre, combination turret lathe be swung over the saddle cover, and the maximum distance obtainable between the spindle nose and the faces of the 6-station turret is 66 in.

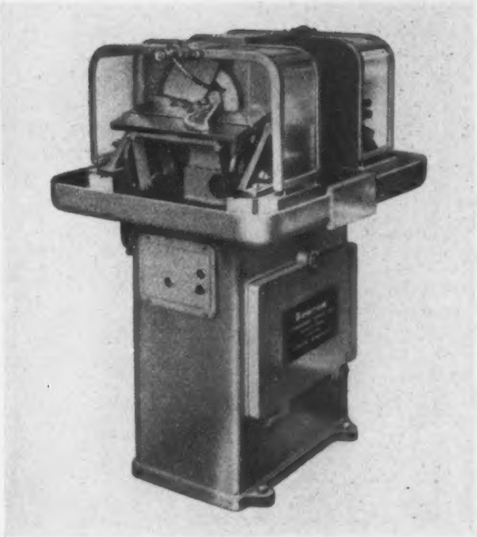
Drive to the headstock is taken from a 12-h.p. motor, and 12 spindle speeds ranging from 15 to 453 r.p.m. are available. The spindle runs in Timken precision taper roller bearings, and is bored 3⅜ in. diameter. The feed gear box permits screw threads from 2 to 28 per inch to be cut. Saddle and turret feeds available range from 12 to 60 cuts per inch. Rapid power traverse of the turret is derived from a separate motor, flange mounted on the apron, and a self-coiling reel is fitted for the power-supply cable.

To facilitate the turning and boring of stepped parts, the sliding movements of the turret and saddle are controlled by stops, adjustably mounted on a 6-station indexing bar at the front of the bed. Front and rear toolposts are carried by the cross slide, and the movements of the latter unit are controlled by adjustable stops on a 4-station indexing carrier.

The lathe weighs approximately 4½ tons, and occupies a floor space of 11 ft. 6 in. by 4 ft. 3 in.

Beacon Type CT.8 Grinding and Lapping Machine for Carbide Tools

Beacon Machine Tools, Ltd., Hurst Lane, Tipton, Staffs., have recently placed on the market the type CT.8 grinding and lapping machine, here shown, for sharpening carbide-tipped tools up to 2 in. thick.



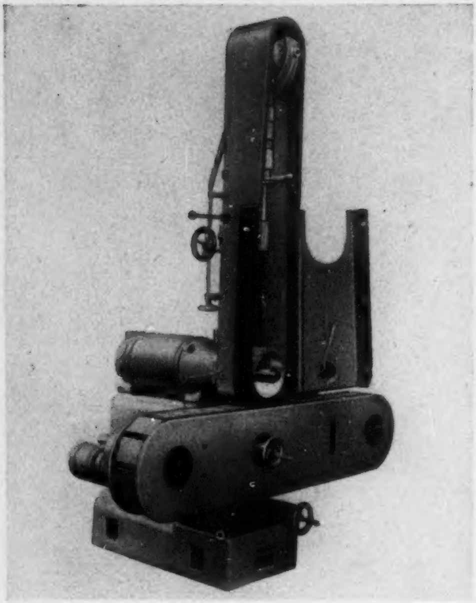
Beacon type CT.8 grinding and lapping machine for carbide tools

Vitrified abrasive and diamond-impregnated wheels of 8 in. diameter can be mounted on both ends of the spindle, which runs in adjustable Timken taper roller bearings, and is driven at a speed of 2,600 r.p.m. by a 1½-h.p. reversing motor, through a V-belt and pulleys. Coolant is delivered to the work by a motorized centrifugal suds pump. The 16- by 8½-in. tables can be tilted through angles up to 10 deg. above and 30 deg. below the horizontal for grinding tools with negative and positive rakes. Adjustments are made by hand knobs, and scales are fitted to permit accurate setting. The tables are supported by steel blades, and friction-free oscillating movements can thus be obtained when grinding or lapping is in progress. As a result, wheel-wear is uniformly distributed. Stops are provided for limiting the oscillating motion, and for securing the tables when wheel dressing is to be carried out.

A dovetail slot for a protractor type stop extends for the length of the table, and provision is made for fitting a motor-driven attachment for grinding chip breaker grooves in tool tips. Splash guards of transparent plastics materials, with light alloy frames, are pivoted at the centre, and the guard at either side can thus be swung to the raised position, as required. The machine weighs approximately 8¼ cwt., and occupies a floor space of 30 by 36 in.

Greif Band Polishing Machine

Shown in the accompanying illustration is the Greif semi-automatic vertical band grinding machine which is designed for grinding or polishing flat surfaces of a wide range of metal objects, such as sole plates of electric irons which are fed on to the work conveyor under the guidance of an operator. The conveyor is composed of a number of flat plates joined together by flexible connections to form an endless belt and it is traversed at speeds which may be varied between 8 and 33 ft. per min. by a push-button controlled f.h.p. geared motor. The conveyor height is adjustable over a distance of 2 in. to enable workpieces of different thicknesses to be ground. An abrasive band, 6 in. wide by 11 ft. 4 in. long, is mounted vertically between two opposed pulleys which are separated by a spring tensioner. The lower pulley functions as a contact wheel, and it is driven by a 13½-h.p. electric motor. The normal working speed of the motor is 3,000 r.p.m. which drives the abrasive band



Greif semi-automatic abrasive band grinding machine

at 7,800 ft. per min. A sheet metal guard encloses the abrasive band, except the lower portion, where it is in contact with the work. Weighing 1,930 lb. complete, the machine has an overall height of 8 ft. 4 in., a width of 5 ft. 10 in. and a depth of 3 ft. 6 in. It is stated to be capable of grinding the surfaces of cast aluminium plates, measuring 10 in. by 5 in., to a smooth finish, at the rate of 500 an hour. This machine is distributed in Great Britain by Roland Goodall Ltd., 19 Station Street, Burton-on-Trent.

Automatic Loading and Unloading Mechanism for Gleason Quenching Presses

To enable the operating speed of the types 16 and 26 quenching presses to be increased, a completely automatic loading and unloading mechanism has been developed by Gleason Works, Rochester, N.Y., U.S.A. In addition, with this attachment the quality of the workpieces can be controlled more closely, as the time occupied in transferring the part from the furnace to the quenching die can be maintained uniform throughout the batch.

The unit is cam-controlled, and the work-handling arms, which are disposed at 90 deg. to each other, are indexed from the loading to the unloading positions by means of a Geneva mechanism. Fig. 1 shows a type 26 quenching machine equipped with the automatic loading unit and set up for handling outer races for bearings. Here, the lower die has been advanced from the quenching area and the inner arm has gripped the treated workpiece, and the outer arm, a fresh part. From this position, the unit is raised and the arms are turned through 90 deg., in the clockwise direction as viewed from above, and then lowered.

Next, the gripping fingers are opened, and the fresh part is allowed to fall into the lower die, and the treated part into a work basket, or on to a conveyor. A close-up view from the other side, with the loading equipment in the position last described, is given in Fig. 2. The machine shown here is a type 16, set up for quenching inner races for bearings. After the lower die has been moved back into the quenching area, the arms are raised, and turned through 90 deg. in an anti-clockwise direction, to the original position, in readiness for the next cycle.

Gleason quenching machines will accommodate round, flat, or irregularly-shaped parts up to 25 in. diameter, and provide for close control

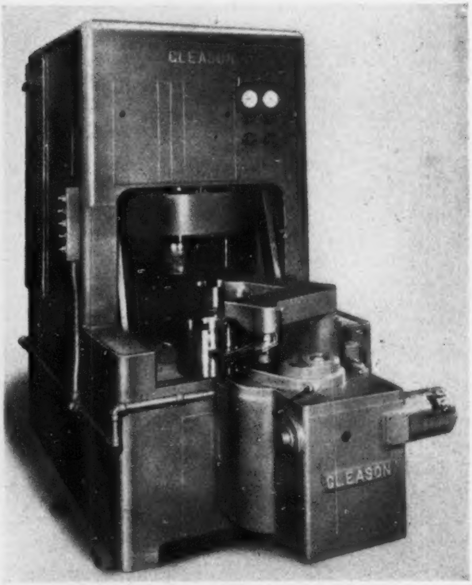


Fig. 1. Gleason type 26 quenching press equipped with an automatic loading and unloading unit, and set up for handling outer races for bearings

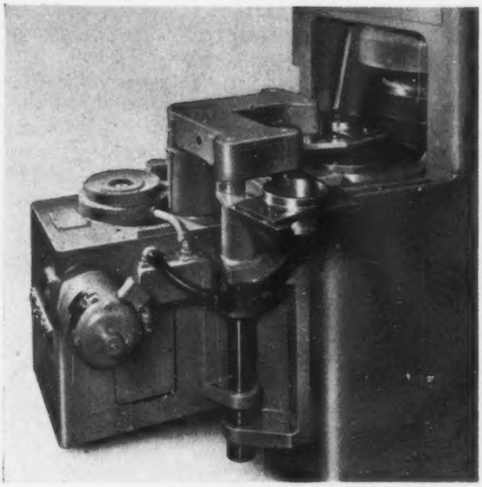


Fig. 2. A close-up view, from the unloading side, of a type 16 Gleason quenching press fitted with a similar loading and unloading unit to that shown in Fig. 1

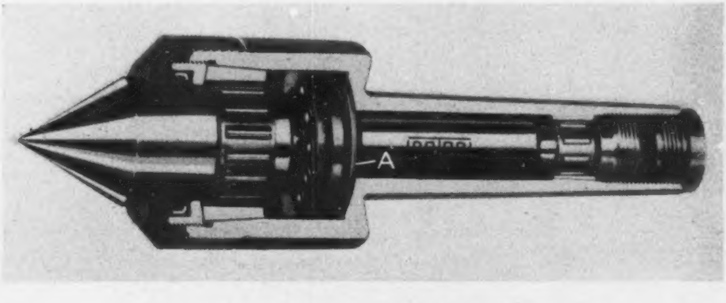
throughout the quenching cycle. During quenching, the parts are held between precision dies, to reduce the amount of distortion to a minimum.

The agents in this country for machines built by Gleason Works are Buck & Hickman, Ltd., Otterspool Way, By-Pass, Watford.

Rotor Spring-loaded Revolving Centre

In the illustration is shown a cut-away view of the latest Rotor revolving centre, which is marketed in this country and the Commonwealth by Insley Industrial Supply Co., Ltd., 21-22 Poland Street, London, W.1. Behind the ball thrust bearing is mounted a plate spring, as indicated at *A*, and this arrangement provides for axial movement of the spindle to compensate for any changes in the length of the work due to heating and cooling.

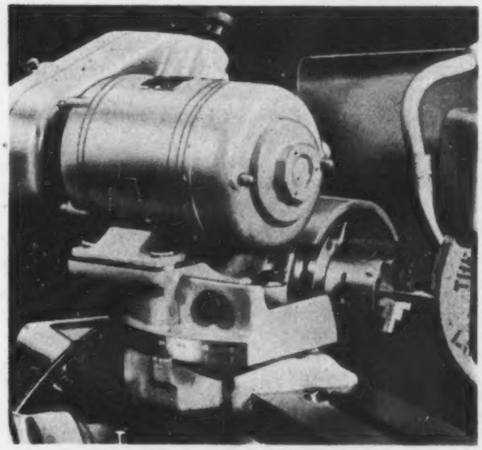
Supported at each end in an adjustable needle roller bearing, the spindle is stated to run concentric within 0·00008 in. The housing is of compact design to avoid interference with cutting tools.



Cut-away view of the rotor spring-loaded revolving centre

Myford Swivelling Workhead for MG12 Cylindrical Grinder

Myford Engineering Co., Ltd., Beeston, Nottingham, have recently developed the swivelling workhead, here illustrated, which is readily interchangeable with the standard head on their MG12 cylindrical grinding machine. With this unit, accurate angular and face grinding can be performed.



Myford swivelling workhead for MG12 cylindrical grinding machine

The live spindle and drive are arranged to reduce work overhang, and permit the use of a large diameter spindle flange, to ensure rigidity and accuracy. Moreover, the workhead swivel point is so located as to provide maximum capacity in front of the spindle when the head is turned to various angular settings.

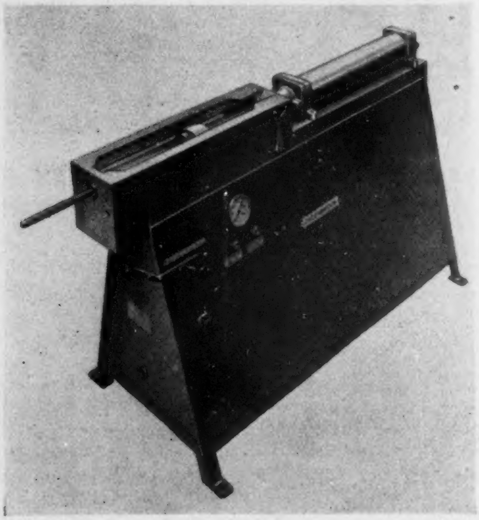
A 3¼-in. diameter 3-jaw geared scroll self-centring chuck, a 4⅝-in. diameter magnetic chuck, 3¼- or 4-in. diameter 4-jaw independent chucks, or a 5 in. diameter faceplate, can be mounted directly on the spindle flange which is provided with a long spigot. The flange is drilled to suit these chucks, and bored to accommodate standard workhead collets.

A speed range similar to that of the standard work-head is provided, namely, 12 speeds from 65 to 670 r.p.m., and the unit is supplied complete with D.C. motor. For face grinding, the spindle drive can be reversed by means of a switch.

Greenbrook 2½-ton Horizontal Hydraulic Broaching Machine

The 2½-ton horizontal hydraulic broaching machine, type 588a, shown in the illustration, has recently been introduced by Greenbrook Engineering Co., Ltd., Padiham, Lancs.

It has a working stroke of 24 in., and can be arranged for push or pull broaching by movement of a lever on the fabricated steel base. The machine can be supplied with working strokes of other lengths if required, and has a capacity for broaching 1 in. diameter holes in 1-in. thick mild steel. The faceplate has a working surface that measures 8 in. square.



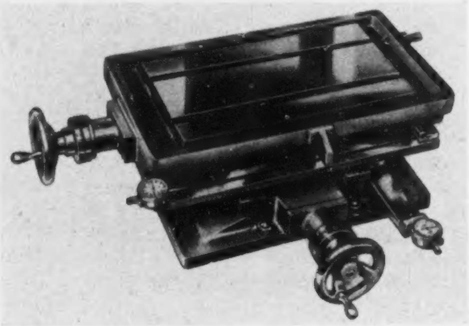
Greenbrook 2½-ton hydraulic, horizontal broaching machine

Oil is delivered to the 4-in. bore hydraulic cylinder at a maximum working pressure of 600 lb. per sq. in., by an annular piston-type pump, which is directly driven from a ¾-h.p., push-button controlled, motor. The steplessly-variable broaching speeds range up to 2½ ft. per min. A large diameter pressure gauge, and knob-operated valves for controlling the working and relief pressures, are mounted on the front of the base, which houses the hydraulic pump and the 5-gal. capacity oil tank.

The machine weighs approximately 5½ cwt., and occupies a floor space of 68 by 28 in.

Grimston No. 1 Compound Work Table

Grimston Electric Tools, Ltd., Progress Way, Croydon, Surrey, have recently placed on the market, the No. 1 compound work table here shown. It has an 18- by 10-in., T-slotted working surface, and incorporates a trough and a drain pipe for coolant.



Grimston No. 1 compound work table

Longitudinal and cross movements of 13 and 6 in. respectively are provided, and the handwheels are fitted with dials which give readings to 0·001 in. Dial indicators and support pieces for slip gauges are also provided. The 15- by 11½-in. base has four slots to take fixing bolts. The overall height of the table is only 5⅝ in.

A larger compound table, designated No. 2, will be available shortly.

DOMESTIC WASHING MACHINES produced during the first six months of this year reached a total of 384,000, of which 113,100 were produced for the export market.

Machining Operations on Honeycomb Material

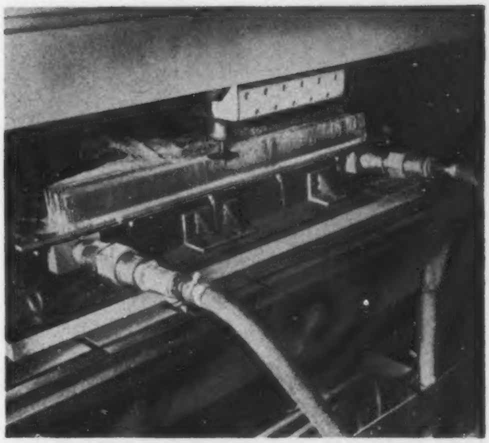


Fig. 1. A Honeycomb Core is Here being Machined with a "Truck-valve" Cutter while Attached with Polyethylene Glycol to a "Caul Plate." The Latter is Mounted on a Manifold Fixture, which can be Heated and Cooled with Water

Metal honeycomb material is being increasingly employed in bonded aircraft structures which have been shown to offer important advantages, for example, from the standpoint of weight-strength ratio, fatigue life, and the greater ease with which clean aerofoil surfaces can be obtained. Moreover, the thin wings now required can be made with honeycomb structure, whereas they would be difficult, if not impossible, to fabricate from spars, ribs, and skin panels.

In the three years that have passed since the Northrop Division of Northrop Aircraft, Inc., Hawthorne, Calif., U.S.A., initiated an extensive programme of fabricating honeycomb-bonded structures, important advances have been made. This article is principally concerned with progress in machining aluminium honeycomb cores. In this connection, much ingenuity was necessary on the part of production engineers in view of the fact that the aluminium material which is formed into honeycomb cores is frequently only 0·0007 in. thick. The heaviest sheet used for this purpose is 0·002 in. thick.

Honeycomb cells range in size from ⅛-in. to ⅜-in. hexagon. Obviously, from the machining standpoint, the honeycomb cores are exceedingly fragile. The lightest sections weigh only 2·3 lb. per cu. ft. and the heaviest sections, 8·1 lb. per cu. ft. Skin panels to which honeycomb cores are bonded range in thickness from 0·008 to 0·025 in.

From this fragile material, a wide variety of shapes must be machined, including wedges that taper down to zero, Cut-outs, steps, and double reliefs must be produced all within

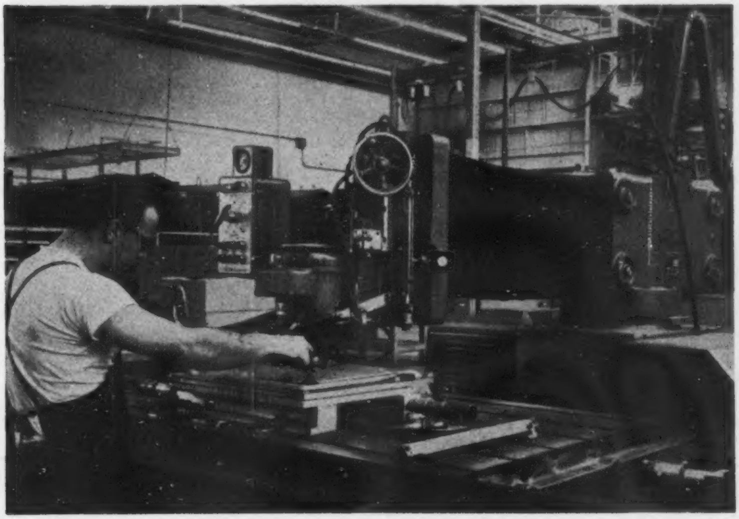


Fig. 2. A Typical Machining Operation is Here being Performed on a Honeycomb Structure on a Routing Machine

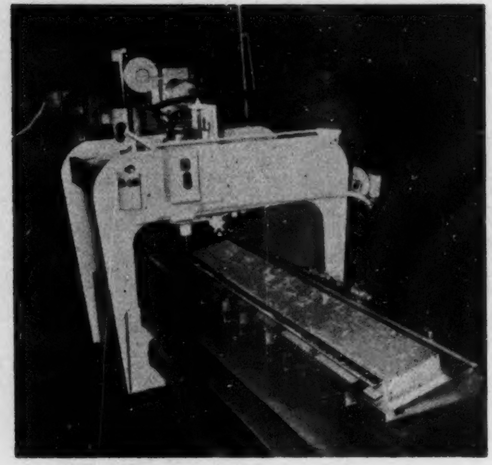


Fig. 3. Long Wedge-shaped Sections of Honeycomb Material can be Produced on this Machine using a Sloping Vacuum Chuck

limits as close as ±0·003 in. In some instances, wedges are formed on presses, and cells must then collapse evenly.

At first it was believed that the individual cells must be reinforced in some manner preparatory to machining operations, so that the surrounding fins would not bend over when a cutter was applied. Consequently, an epoxy resin was melted and poured into the honeycomb cells, and the part was milled after the resin had solidified. This method proved costly, and sometimes the resin could not be removed entirely. It was finally decided that the honeycomb core could be satisfactorily machined if attached to a skin or spar. This procedure has proved satisfactory, and is characteristic of present Northrop practice. In some instances, the honeycomb core is attached to a "caul plate" instead of a skin, and is held on a machine by using a vacuum chuck.

Generally, the honeycomb core is attached to a skin or caul plate by the use of polyethylene glycol, which is a water-soluble, wax-like material having a melting point between 160 and 180 deg. F. The "polyglycol" has excellent gripping properties, serves as a lubricant when machining filled cores, enables machining to be carried out at room temperature, and can readily be removed from the work by melting and washing in hot water. Also, it is comparatively inexpensive, and can be used repeatedly.

The aluminium caul plates are chemically milled on one side, which gives them a pitted surface that is ideal for bond retention. A machine table with hot and cold zones is provided, and a caul plate is placed on the hot zone to melt the polyglycol when a honeycomb core is to be attached. Then the caul plate is moved to the cold zone, the honeycomb core is pressed on, and the polyglycol solidifies quickly. Intimate contact of cores with the caul plates is assured by this method.

Some machines are equipped with work-holding fixtures provided with manifolds for the supply of hot and then cold water for melting and setting the polyglycol. The fixture shown in Fig. 1 is of this type. In general, however, the use of caul plates saves idle machine time between operations.

Various types of cutters were originally used

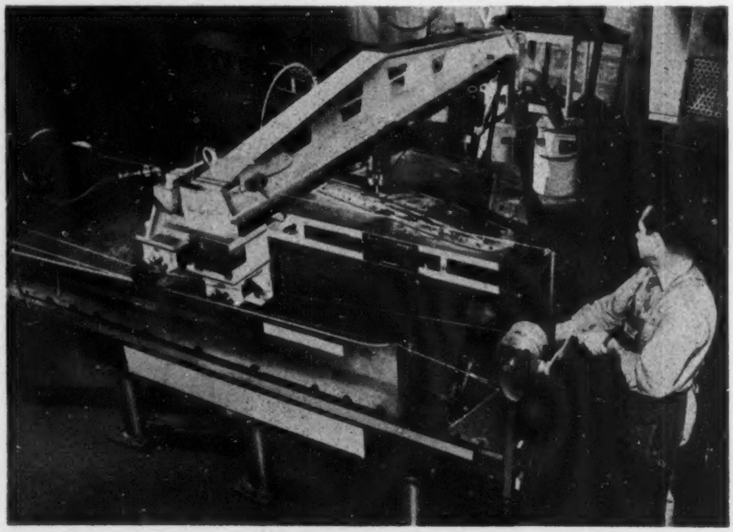


Fig. 4. On the "Apex" Machine, the Cutter can be Fed to and fro Along the "Construction" Lines of a Wing Section

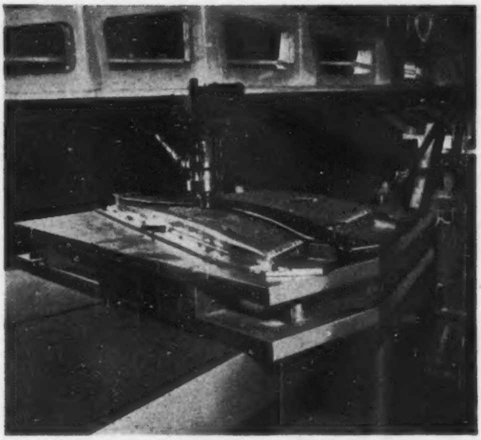


Fig. 5. Close-up View of the Machine in Fig. 4 Arranged for Taking Step Cuts Transversely on a Wing Section

for machining honeycomb cores, but with only fair success. Finally, the type of cutter seen on the machine in Fig. 1 was adopted. It is sometimes known as a "truck-valve" cutter, and it may be noted that the first cutters of this type used by Northrop were in fact produced by grinding commercial vehicle engine valves. The cutters in most common use today closely resemble those employed initially. There are no teeth or serrations around the circular edges which are kept razor-sharp. Cutters of the "fly" type, with only a circular segment for a cutting edge, are used for heavy steel removal. Because of their appearance, these tools are termed "propeller" cutters, and they remove as much as 1 in. thickness of honeycomb core at a pass. Normally, from 0·025 to 0·050 in. of stock is left when roughing for removal by finishing cuts. Both types of cutter are run at 5,000 to 6,000 surface ft. per min.

Machines are employed on which the cutter is fed automatically across the honeycomb core to produce surfaces of varying contours, but in some instances the cutter is guided by hand. A manually-controlled machine is illustrated in Fig. 2. Of the router type, it has a head mounted on an arm that pivots on a carriage, and the latter can be moved along the back of the machine table. By means of a handle, the operator guides the cutter over the work for removing stock to the required depth.

The table provided for this Wadkin router is 25 ft. long, and one man can set up a number of jobs, and can remove the work that has been completed, while another operator is finishing a part. Machine idle time is thus considerably reduced. The material handled on this machine is invariably mounted on caul plates.

Long wedge-shaped parts are produced by the use of the planer-type machine in Fig. 3, which is equipped with a sloping fixture. The cuts are taken by feeding the table to and fro beneath the cross-rail. The fixture is a vacuum chuck.

An interesting machine employed in this plant for contouring honeycomb structures is the "apex" unit illustrated in Fig 4. It is so called because it incorporates a swinging cross-rail which pivots on a 4-in. diameter ball on a column, the latter being so located with respect to the table that a wing section can be mounted with all construction lines terminating at the pivoting point.

With the cutter-head connected to a lead-screw, so that it can be fed to and fro along the cross-rail (not as shown in the illustration), and by intermittently feeding the outer end of the rail along the far end of the table, cuts can be taken longitudinally over the wing section. These movements of the cutter on the cross-rail are effected automatically. Meanwhile, the cross-rail is indexed

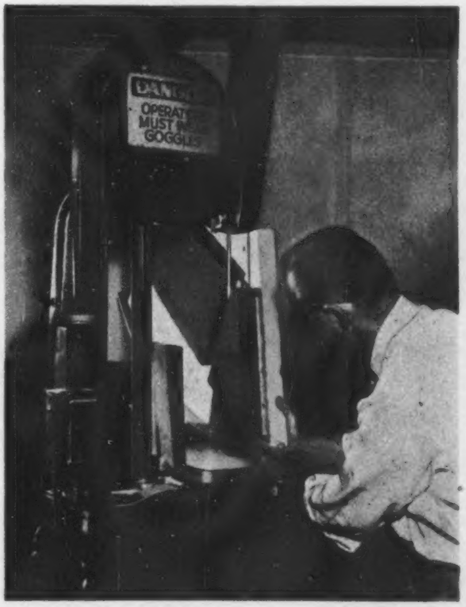


Fig. 6. Vertical Type Bandsawing Machine with a Table which is Pivoted at an "Apex" to Permit of Cutting Tapered Wing Shapes from Honeycomb Core Material

by the operator who turns the handle at the far end of the table, as seen in Fig. 4.

In Fig. 4 and 5 a step cut is being taken over a honeycomb core that has previously been machined to the prescribed curvature by causing the cutter to follow the wing construction lines, as mentioned. In taking transverse cuts as seen in these illustrations, the cutter is guided in the prescribed path by a roller above it, in contact with a cam bar or template mounted across the work.

With this arrangement, step cuts or cut-outs across the honeycomb structures can readily be made along regular or irregular paths. Continuous movement is imparted to the outer end of the cross-rail by turning the handle, as seen in Fig. 4.

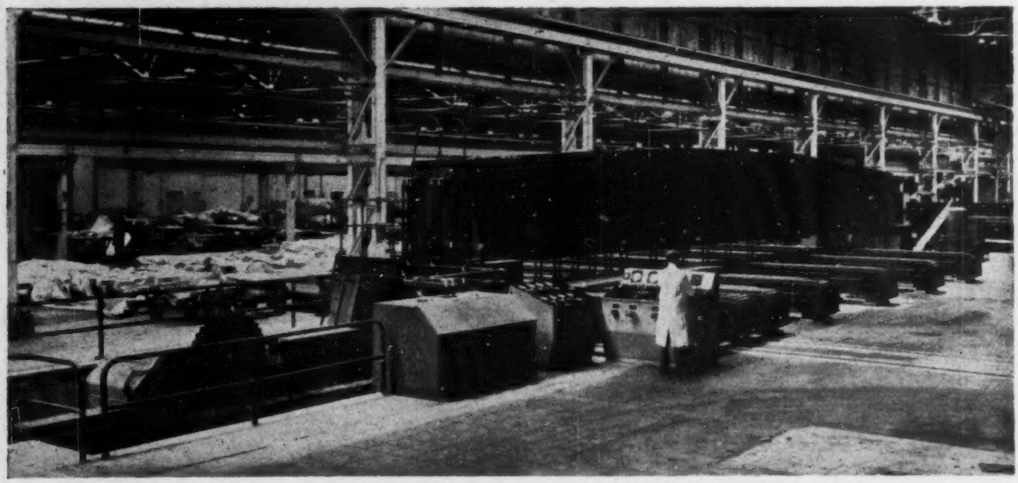
Sections of honeycomb core can be conveniently cut to tapered wing shapes by means of the vertical bandsaw in Fig. 6. This machine is fitted with an auxiliary vertical table which is pivoted at the top and guided by a cam at the bottom. A horizontal bandsaw, equipped with a pivoted work fixture, is employed to cut material to compound angles.

Large Wadkin Sawing Machine for Aluminium Plate

The large sawing machine shown in the accompanying figure, which was designed and built by Wadkin, Ltd., Leicester, is installed at the Monmouthshire Works of the Northern Aluminium Co., Ltd., and is capable of cutting non-ferrous plate up to 57 ft. long by 10 ft. wide by 6 in. thick. The work is held by 18 pairs of hydraulic clamps, carried in a 68-ft. long beam, and the saw spindle is driven by a 75-h.p. motor.

Several 50-in. diameter carbide-tipped saws were supplied for the machine by Spear & Jackson, Ltd., Aetna Works, Savile Street, Sheffield, 4. These saws were specially designed and tensioned to run at peripheral speeds up to 13,500 ft. per min., and have bevelled roughing teeth and square finishing teeth of similar form to those employed for the company's Spearseg high-speed steel segmental saws. A tooth pitch of 4 in., with a deep gullet, was found to give the most satisfactory results, and tests have shown that the saw can enter the work at full peripheral speeds and feeds without damaging the teeth. When cutting thin sheets of Noral 26S material, a high-strength aluminium alloy containing copper, a feed rate as high as 180 in. per min. is employed.

To ensure concentricity, the top clearance angle of each tooth is lapped to within ±0·001 in. with a diamond wheel.



Large Wadkin Sawing Machine for Aluminium Plate Installed in the Works of the Northern Aluminium Co. The 50-in. Diameter Carbide-tipped Saw was Supplied by Spear & Jackson, Ltd.

Verdict-Dow Dial Indicator Gauging Equipment

In Fig. 1 is shown an example from the range of dial indicator gauging equipment which A. Capp & Son, Ltd., Thames Road, Crayford, Kent, have recently started to make under licence from the Dow Mechanical Corporation, Thompsonville, Connecticut, U.S.A.

Work holders of different designs, which can readily be made from standard blanks, or built up to suit requirements, can be mounted on the base, for checking a wide variety of components of small and medium size. An adjustable work holder is available which enables diameters ranging from ¼ to 1 in. to be inspected. The equipment illustrated is fitted with a special work holder for checking an internal groove in relation to a taper bore on a fountain pen component.

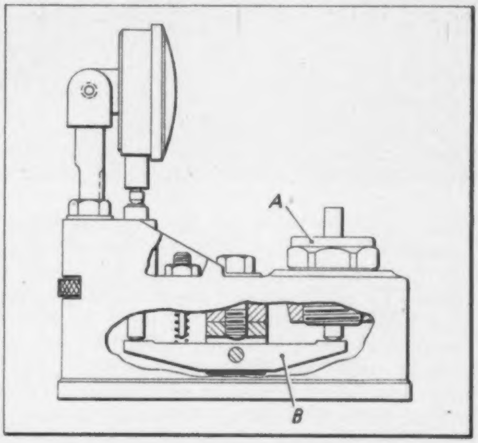


Fig. 2. Diagram indicating the operating principle of the gauge shown in Fig. 1

Referring to the line drawing, Fig. 2, which shows the basic gauging unit, partly in section, the base has a threaded hole to take the work holder A. At the opposite end of the base to the work holder, there is a threaded column to carry the dial indicator, which can be adjusted vertically by means of a knurled ring. During the gauging operation, vertical movement of a measuring plunger in the work holder is transmitted in the ratio of 1 to 1 by the lever *B*, to a second plunger, which can slide in a bore in the base, and operates the dial indicator.

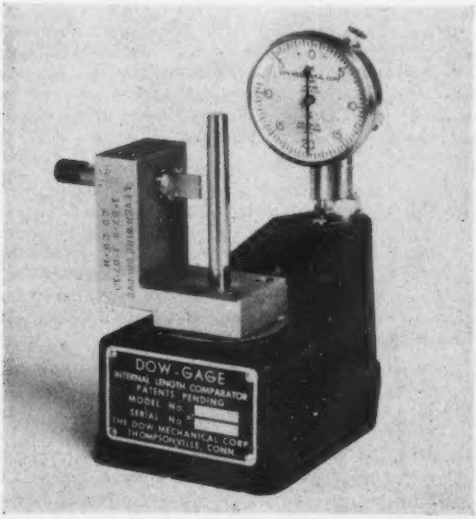


Fig. 1. Dow dial indicator gauge set up for checking a fountain pen component

Made from hexagon steel bar, of 1⅜ in. across flats, the work holder blank has a thread at one end, and is available with solid cylindrical portions ranging up to $1\frac{11}{32}$ in. diameter by 1¾ in. long, which can be bored and turned, as required, to suit the component. Among operations that can be carried out with this equipment may be mentioned the checking of internal and external diameters and lengths, positions of holes, squareness of faces, angles and concentricity of tapers, depths of slots, and pitch radii of gears.

In Fig. 3 is shown the patent Dow Tacomp dial indicator comparator. Although primarily intended for the accurate inspection of tapers for angle, this comparator may be fitted with end pieces made from the workholder blanks previously mentioned, which enable a variety of other shapes to be checked while the component is set-up on a machine. For checking an internal taper, a flange on the end piece attached to the body and a disc secured to the measuring plunger are brought

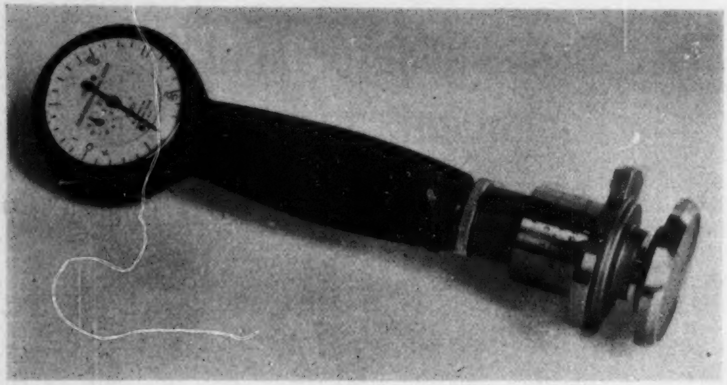


Fig. 3. Dow-Tacomp dial indicator comparator

into contact with the bore, and a reading is thus obtained on the dial indicator. Any deviation from the zero setting of the indicator, which is obtained by applying the comparator to a master bore, indicates a difference in taper angle. A conversion constant is usually marked on the end piece, to enable the difference in taper corresponding to the indicator reading to be readily calculated in terms of degrees, minutes or seconds of arc. The instrument illustrated is arranged for checking an internal spherical surface on a gas turbine part, and the flange on the end piece has three cut-away portions, so that it may be passed through a splined bore.

If required, three short, equally-spaced, contact lands can be provided on the flange, and readings may then be taken at different angular positions in the bore, which can thus be checked for roundness. For checking taper bores for straightness, two comparators are used, which are set for different distances between the contact points on the flange and the measuring disc.

The British-made units are known as Verdict-Dow gauges, and examples will be shown in London at the forthcoming Eleventh Engineering display of the Engineering Industries Association.

Trade Publications

Magnetic Devices, Ltd., Exning Road, Newmarket. Four leaflets, No. MD 27 to 30 inclusive, giving details of the company's recently-introduced ranges of magnetic relays, including an interlocking unit, a plug-in enclosed type, and the series 285 which is intended for automated installations.

W. Watson & Sons, Ltd., Barnet, Herts. Illustrated catalogue giving particulars of industrial stereoscopic microscopes, with magnifications ranging from 3 to 140 ×. There are two types of binocular heads, one with parallel, and one with inclined eyepieces, and ranges of mounting bases, feet, and bench stands. A workpiece illuminator is also available, which can either be attached to the binocular head, or mounted independently on a heavy base.

Autoflow Engineering, Ltd., Lawford Road, Rugby. Catalogue covering a wide range of Diagrit metal-bonded diamond wheels, drills, and hones. A section is devoted to applications, recommended methods of mounting, speeds and feed rates, types of coolant, and details of the re-truing, forming, and salvaging services which are offered by the company. A separate leaflet describes the Hyrange 315 machine, which is primarily intended for cutting and truing toric tools for use in the lens manufacturing industry, but can also be employed for tools of spherical form.

Acheson Colloids, Ltd., P.O. Box No. 12, Plymouth. Bulletin No. 101 describes the applications and advantages of dag colloidal graphite in the glass industry, as a lubricant and parting agent. Among the subjects covered are automatic spray application, the pre-treatment of tools and moulds, and the lubrication of chutes and belt conveyors.

William Jessop & Sons, Ltd., Brightside Works, Sheffield. Information sheet No. M811 gives comprehensive information concerning the corrosion resisting properties of titanium in relation to mineral acids, inorganic salts, organic compounds, gases and gaseous media, and galvanic action. A comparison is also presented of the corrosion-resisting properties of titanium and austenitic 18/8 + Mo. stainless-steel.

Sanderson Brothers & Newbould, Ltd., Attercliffe Steel Works, P.O. Box No. 6, Newhall Road, Sheffield. Booklet containing a summary and specifications of the company's range of steels, including the Saben series of high-speed steels; alloy tool and die steels for hot and cold work; shock-resisting carbon tool steels; and water-hardening tool steels. Illustrations are given of typical press tools, punches, and dies, and a list is included of the company's general engineering steels and their British Standard specification equivalents.

News of the Industry

Glasgow and District

Recent months have seen little change in activity in the Clydeside shipyards and marine engineering establishments, on account of the large volume of orders still in hand. During this year, however, fresh contracts for new vessels and for repair work have been on a considerably reduced scale. Iron and steel producing plants and many foundries in the area are experiencing quieter conditions, and some short-time working is reported. Makers of electrical plant, coal-mining machinery, all types of cranes, and fabricated steelwork are generally doing good business. In the machine tool industry order books are sufficient to maintain full-time employment, but new bookings leave much to be desired. Since our last visit additions to plant have been on a reduced scale.

JOHN LANG & SONS, LTD., Johnstone, are fully occupied on a programme of standard centre lathes, ranging from 13 to 36 in. swing, and surfacing and boring lathes, from 17 to 48 in. swing, which are destined for both the home and overseas markets. Other orders cover hydraulic copying and oil country lathes of various sizes. A well-maintained demand is reported for the firm's standard and special hydraulically- and pneumatically-operated chucks.

CLIFTON & BAIRD, LTD., Johnstone, have orders in hand for various sizes of their front-cutting-type, heavy-duty, high-speed, cold metal sawing machines, with saws from 18 to 44 in. diameter, vertical sawing machines, and automatic saw sharpeners. Other work includes two combined rail sawing and drilling machines, one for the home market and one for export, and a rotary end milling machine for structural steelwork with a 54-in. diameter cutter head. A Butler 26-in. stroke shaping machine has recently been installed.

SCOTTISH MACHINE TOOL CORPORATION, LTD., 17 Lynedoch Crescent, Charing Cross, Glasgow, have a good volume of work in progress, for both home and overseas customers, at the works of the member firms, namely, Craig & Donald, Ltd., Loudon Bros., Ltd., G. & A. Harvey, Ltd., and James Bennie & Sons, Ltd., of which some details follow.

CRAIG & DONALD, LTD., Johnstone, have a satisfactory order book for plate-working machinery for various destinations, including hydraulic press brakes ranging in sizes from 120 tons by 10 ft., up to 350 tons by 25 ft., and 400 tons by 17 ft., also hydraulic guillotine shears from 6-ft. by ⅜-in. up to 10-ft. by ¾-in. capacity. Other equipment in progress includes universal and Lolift type folding machines, plate bending rolls, and section ring curving machines with capacities up to 6- by 6-in. angle. The latest addition to the plant is an Archdale 6-ft. radial drilling machine.

LOUDON BROS., LTD., Johnstone, are well placed for orders for planing machines of the double-

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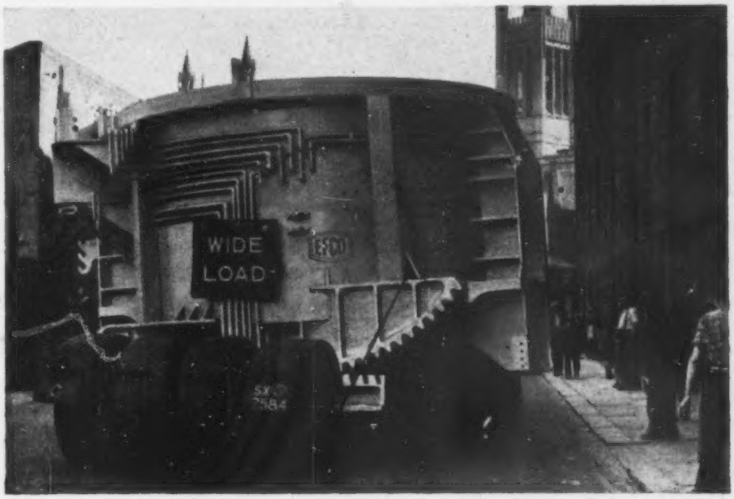


The illustration shows an electric steel melting furnace body by Efco, Ltd., Netherby, Queen's Road, Weybridge, being transported to Aberdeen Docks. Destined for Vancouver, B.C., it weighs approximately 100 tons

standard type, in sizes up to 10 ft. wide by 8 ft. high with 21-ft. stroke, and openside-type machines for widths of 4 and 6 ft. and with strokes up to 20 ft. A wall-type horizontal and vertical planing machine in hand has longitudinal and vertical traverses of 20 and 15 ft. respectively, and a column-type horizontal and vertical planer covers a vertical surface of 20 by 6 ft. We also noted carriage and wagon wheel lathes in progress, including a floor-level type machine designed for producing the complete wheel profile, to which we hope to make further reference. A screwcutting break lathe, recently delivered to the Admiralty, is fitted with a 7 ft. 6 in. diameter chuck. It will swing work up to 8 ft. diameter, and admits 28 ft. between the centres. A new pattern shop is being erected at these works and two Denham 12-in. centre lathes have recently been installed.

G. & A. **Harvey, Ltd.**, Glasgow, have a variety of single- and two-point, straight-sided and open-fronted, mechanical and hydraulic power presses in hand, in capacities from 100 to 400 tons. Lathes on order include 18 and 24 in. centre screwcutting types, to admit 24 and 30 ft. between centres, and a 6-ft. swing surfacing lathe. Our attention was drawn to a recently-developed 30-in. swing boring and facing machine, of simplified design, on which a variety of main and feed drives can be incorporated. We hope to describe this machine in due course. Ingot slicing machines on order for export will handle ingots up to 24 in. diameter by 10 ft. long, and as many as 16 tools can be employed.

James Bennie & Sons, Ltd., Glasgow, continue to do a good home and export business with their cold-type, hydraulic, ship's frame bending machines for 17-in. channels, also with the smaller version of this machine for dealing with 12-in. channels. Other orders cover a 60-ft. by 2-in. plate-edge planing machine with hydraulic handling equipment, which is destined for Dorman, Long & Co., Ltd., for use in connection with the construction of the new Forth Bridge; plate bending rolls up to 12-ft. by 1¼-in. capacity; plate straightening rolls; and shipyard-type bending rolls. We hope shortly to describe a large set of straightening rolls for 11-ft. wide by 2-in. thick plates, which has recently been supplied to Harland & Wolff, Ltd., Belfast. Work in progress also includes a 10-ft. by 1-in. hydraulic guillotine shearing machine, punching and shearing machines of various capacities, cropping machines with feed tables, and one-man punching tables. A fair proportion of the work in hand is destined for overseas customers.

Durable Tools, Ltd., Glasgow, report a steady demand for their ranges of collapsible taps, adjustable taper threading taps, adjustable reamers and cutter heads. Other activities at these works include the production of jigs, fixtures, gauges and moulds, and precision boring work is undertaken on a Société Genevoise jig borer.

Babcock & Wilcox, Ltd., Renfrew, have recently received a repeat order for a boiler, valued at about £400,000, from C. A. La Electricidad De Caracus, Venezuela. H. B.

Coventry Gauge-Rockwell Merger

In connection with the merger of The Coventry Gauge & Tool Co., Ltd., and the Rockwell Group, to which reference was made recently in Machinery, it is announced that Sir Stanley J. Harley, B.Sc., M.I.Mech.E., will join the board of Rockwell and will become chairman, and that Mr. W. J. Foster will also be a director. Mr. C. E. Rockwell will join the board of Coventry Gauge & Tool Co., Ltd., as a managing director, and Mr. J. Middleton will be a director of the company.

The combined organizations have very extensive facilities. Founded by the late Sir Harry Harley in 1913, The Coventry Gauge & Tool Co., Ltd., introduced the first Matrix thread grinding machine at the end of the 1914-18 war. Initially a single-rib wheel was employed, but later a diamond dresser for multi-rib wheels, patented by Sir Stanley Harley, was incorporated. During the second world war the scale of the company's activities was greatly expanded and at one time the employees numbered 6,000. A very large output of gauges was maintained, and in addition to thread grinding machines, the company produced measuring instruments, cutting tools, gunnery control equipment, and special-purpose machine tools, including root form grinding machines for gas turbine blades.

Today, the main works at Coventry provide employment for some 1,800 people, and the principal products are machine tools, including "American" broaching machines, which are built under licence, broaches, measuring instruments, and gauges. In addition Admiralty work is carried out, and broaching, thread grinding, and gear grinding are undertaken for the trade. Apart from the main works, there are five other factories and the principal products are as follows: Brechin, Angus—medium size thread grinders, "American" broaching machines, lapping machines, cylindrical grinders, and British-built Thompson grinders. Arbroath—Matrix clutches and thread gauges. Bradgate Street, Leicester—Matrix slip gauges and Micro-Mag internal measuring equipment. Ratby, Leicestershire—broaches. Madeley, Shropshire—small machine tools and measuring equipment.

Some years ago, Pitter Gauge & Tool Co., Ltd., Woolwich, S.E.18, became a wholly-owned subsidiary of Coventry Gauge. This company produces special tooling and gauges for customers in the London and Home Counties area, and special provision has been made for work in connection with the atomic energy programme.

In all, the employees at these works number nearly 3,000, and it may be noted that more recently introduced products include gear grinding machines, also dividing heads and circular tables arranged for optical projection screen reading.

Since the second world war, subsidiary companies have been established in Canada and Australia.

Primarily concerned with the sale of British and imported machine tools, the Rockwell Group holds numerous American and Continental agencies, including Giddings & Lewis, Monarch, Sundstrand, Thomson, Rockford, Thiel, Werner, Schutte, Jung and Hille. Prominent among machines which are made in this country under licence are British Clearing power presses, built by Vickers-Armstrongs (Engineers), Ltd., and under a recently-concluded agreement the latter company will also make McKay metal processing and forming equipment to the designs of the McKay Machine Co., U.S.A. Other items built by sub-contractors includes U.S. multi-slide machines, press room equipment, and die lapping machines.

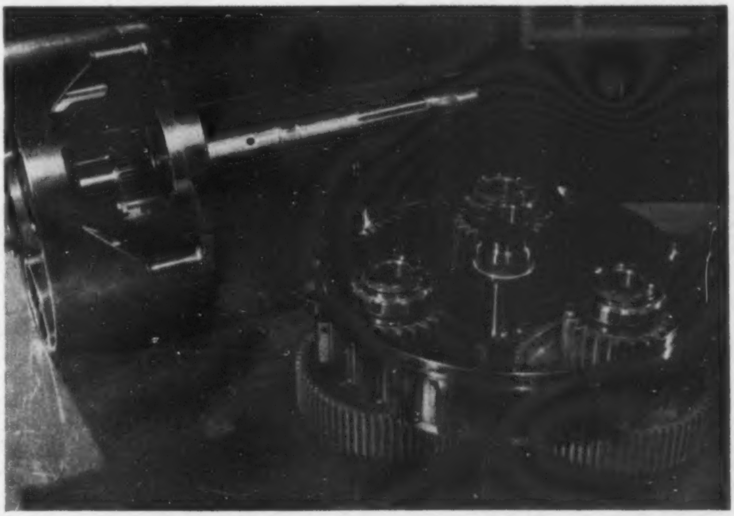
Sales are handled by the Rockwell Machine Tool Co., Ltd., who have showrooms in London and Birmingham, with branch offices in various centres, and provide an extensive engineering service. Used machine tools are sold by A. Lawrence & Co. (Machine Tools), Ltd.

Some months ago Rockwell became a partner with Pneumatic Scale Co., U.S.A., and Vickers-Armstrongs (Engineers), Ltd., and a new company, Rockwell Pneumatic Scale, Ltd., was formed. A separate organization has been built up to deal with the sale of automatic packaging and filling machines of American design, which are being built by Vickers-Armstrongs.

Shell-Mex Film on Gears

A new film entitled "An Introduction to Modern Gears," which should be of particular value for apprentice training, was recently shown by Shell-Mex & B.P., Ltd., Shell-Mex House, Strand, London, W.C.2. This film, which was also seen by delegates to the International Conference on Gearing organized by the Institution of Mechanical Engineers, briefly covers the subject under the following general headings: types of gears; the characteristics of rolling friction associated with gears having parallel and intersecting shafts; the principles of gear design; the main techniques of cutting and generating gear teeth; gear lubrication; operational testing and research including the photo-elastic technique; and gear trains in present-day use.

In the section of the film concerned with rolling friction, a demonstration rig built by the Pennant Display & Engineering Co., Ltd., Cheltenham, Glos., was shown. Similar in appearance to a tape recorder, the unit incorporates two vertical spindles, one of which is driven by a motor, and on each spindle a plastics spur gear is mounted. The gears are arranged to mesh, and there are red marks on the tooth profiles above, below, and on the pitch circles. When the gears are slowly rotated, the relative movements of the marks at the points of contact can be studied. The equipment can also be used to demonstrate how involute tooth forms



The epicyclic gear incorporated in the Napier Eland gas turbine engin for the Fairey Rotodyne aircraft

are generated from a straight-sided rack profile.

Sequences filmed in the laboratories of the Parsons and Marine Experimental Turbine Research and Development Association, Wallsend, Northumberland, show the testing, to destruction, of gears for the transmission systems of ships, and it is explained how the vibrations of such gears under load are recorded on magnetic tape for subsequent analysis on cathode-ray oscilloscopes. Evidence of impending failure is thus afforded before a breakdown occurs. There is also a demonstration of the photo-elastic technique, meshing gears of transparent plastics material being rotated in a polarized light beam whereby the stresses set up in the teeth are rendered visible.

The accompanying illustration is taken from the concluding portion of the film, which is concerned with gear trains in current use. It shows the epicyclic reduction unit, comprising annulus, sun gear, and three planetary gears, which is incorporated in the Napier Eland gas turbine engine for the 40-seater Fairey Rotodyne aircraft. At take-off rating, this unit transmits 3,765 shaft h.p. at a speed of 12,500 r.p.m.

Planned by the Shell-Mex Company and made by Random Film Productions, Ltd., the film runs for 31 min., and copies can be obtained, free of charge, on loan, in 16- and 35-mm. sizes, on application to any local divisional office of Shell-Mex & B.P., Ltd. The technical adviser was Dr. H. E. Merritt, M.B.E., M.I.Mech.E.

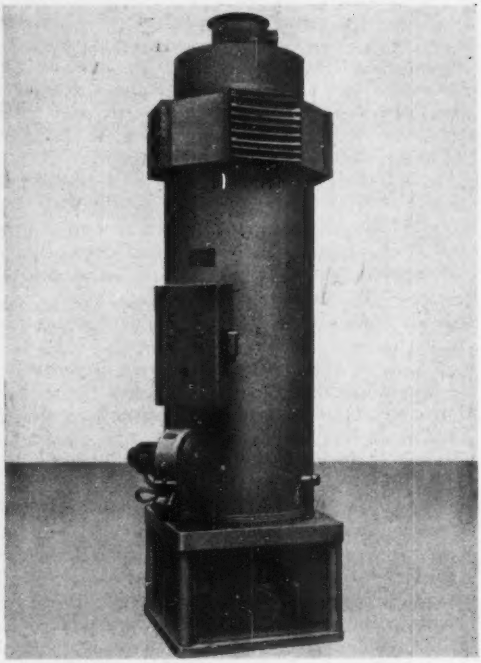
Beacon Industrial Space Heater

The first Beacon industrial air heater, here shown, was recently demonstrated by the manufacturers, John Thompson Beacon Windows, Ltd., at their Wolverhampton works.

Standing 11 ft. 3 in. high and occupying a floor space of 9 sq. ft., the Beacon heater has an output of 320,000 cu. ft. of warmed air per hour, with a maximum hourly consumption of 3¾ gal. of fuel oil, at a thermal efficiency of 87 per cent.

Cold air is drawn into the base of the unit by an axial flow fan driven by a 2-h.p. motor. After passing over the heating surfaces of the combustion chamber, the air is circulated among an array of waste heat tubes, and, finally, is discharged through four warm-air outlets fitted with louvres. A cylindrical baffle inside the main casing encloses the combustion chamber and part of the bank of tubes, and the exterior surfaces of the heating unit are thus maintained at a low temperature.

The oil burner is fitted with a flame failure protection unit. A thermostat with a variable setting is used to control the duration of the heating period and, once set, regulates the heater automatically. The heater is self-contained and by virtue of its low weight (less than 12 cwt.) can be moved into position with little effort. Fuel supply for the burner is usually obtained from a small feed pipe connected to an outside storage tank.



Beacon oil-fired industrial space heater

Coming Events

INSTITUTION OF ELECTRICAL ENGINEERS.—*Mersey and North Wales Centre.* October 20, at 6.30 p.m., at the Royal Institution, Colquitt Street, Liverpool; discussion on "Electronic Control of Machine Tools," opened by D. T. N. Williamson.

THE PLASTICS INSTITUTE.—*Scottish Section.* October 22, at 7.30 p.m., at More's Hotel, Glasgow; lecture on "Stelvetite," by F. H. Smith.

INSTITUTION OF PRODUCTION ENGINEERS.—*Norwich Section.* October 22, at 7.30 p.m., in the Section Room, The Assembly House, Norwich; colour film with sound, on "Die Casting—How Would You Make It?" by A. R. L. Chivers. *London Section.* October 23, at 7 p.m., at the Royal Empire Society, Northumberland Avenue, Strand, W.C.2; lecture on "Alloy Steels" (History, Manufacture and Applications), by R. E. Linton.

INSTITUTION OF MECHANICAL ENGINEERS.—*Eastern Branch.*

October 23, at 7.30 p.m., at Hoffmann Hall, Chelmsford; lecture on "Clean Rooms for the Assembly of Electrical and Mechanical Instruments," by H. G. Harris. *North Western Branch. Industrial Administration and Engineering Production Group.* October 23, at 6.45 p.m., at the Engineers' Club, Albert Square, Manchester; lecture on "Development of Sintered Oxide Tools," by R. N. Cook. *Southern Graduates' Section.* October 21, at 7.30 p.m., at Reading Technical College; lecture on "Electronics for Mechanical Engineers," by R. G. Davis. *London Education Group.* October 22, at 6 p.m., at the Institution, 1 Birdcage Walk, S.W.1; discussion on "Recent Developments in Engineering Education in the U.S.A."

Personal

Mr. J. H. W. Hayes, who has been appointed managing director of the recently formed Tungsten Manufacturing Co. (1958), Ltd., Tremlett Grove Works, Tremlett Grove, London, N.19, joined the former company (Tungsten Manufacturing Co., Ltd.) 12 years ago. As announced elsewhere in this issue of Machinery, the new company has acquired the assets of the latter organization, and will carry on the business.

Mr. J. H. W. Hayes

Mr. J. Hodkinson

Mr. J. Hodkinson has been appointed a director of Wickman, Ltd., Coventry, with overall responsibility for the company's machine tools export interests. He will retain his existing appointment as managing director of Machine Tools (India) Private, Ltd. (a Wickman associated company) which he assumed upon joining that company in June, 1954.

Mr. Hodkinson is well-known in machine tool circles in this country and India. Prior to joining Wickman, Ltd., he had held appointments with the Associated British Machine Tool Manufacturers' Indian company, and Craven Bros. (Manchester), Ltd. During the war he was Deputy Director-General (Tools) and Machine Tool Controller with the Government of India.

Mr. Geoffrey N. Iley, B.Sc.(Eng.), G.I.Mech.E., Grad.I.Prod.E., has been appointed production manager of Morris Motors, Ltd., Cars Branch, Cowley, Oxford. He was formerly a production engineer with the Staffordshire Steel Construction Co., Ltd., and the associated companies, and, later, assistant general manager of the M.G. Car Co., Ltd.

Mr. W. Bates is leaving George Richards & Co., Ltd., and Tilghman's, Ltd., for whom he has been publicity manager, to take up the post of advertising executive with Aerialite, Ltd., Stalybridge.

Mr. J. M. H. Berry and Mr. M. M. Westmorland have been appointed chief engineer and sales manager, respectively, of Edward Holme & Co. (1931), Ltd., Moss Lane, Altrincham.

Mr. Richard Turner has been appointed managing director of Johnson, Matthey & Co., Ltd. He has relinquished his appointment as managing director of Mallory Metallurgical Products, Ltd., a subsidiary company, but retains a directorship.

Mr. Leonard Baker, M.I.Mech.E., A.M.I.Prod.E., has been appointed deputy managing director of Coventry Gauge & Tool Co., Ltd. Mr. Baker, who is also a member of the American Society of Mechanical Engineers, was previously with Hamworthy Engineering Co.

Mr. G. A. Pratt, F.I.A.C., has relinquished the position of managing director of Pratt, Levick & Co., Ltd., Chester, but will continue to serve the company as executive chairman, also in advisory and consultative capacities. Mr. Hugh Pratt, A.M.I.Mech.E., has been appointed managing director in succession to Mr. G. A. Pratt.

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15/10/58

Industrial Notes

The Lapointe Machine Tool Co., Ltd., Otterspool, Watford By-Pass, Watford, Herts. The telephone number of this company is now Watford 31711.

Ottermill Switchgear, Ltd., have moved their London offices to 82 Victoria Street, London, S.W.1 (telephone number, Abbey 5095).

Acheson Industries (Europe), Ltd., have recently moved their offices in London to 1 Finsbury Square, London, E.C.2 (telephone number, Monarch 5811).

Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, Otterspool Way, Watford-by-Pass, Watford, Herts., inform us that their telephone number has been changed to Watford 26091.

An Auction Sale of Machine Tools and miscellaneous stores from the Technical Stores Depot, Old Dalby, Melton Mowbray, Leics., will be held at Melton Mowbray on November 5 and 6. The auctioneers will be Shouler & Son (Dept. N.), 1 Norman Street, Melton Mowbray.

Technical Control in Electroplating will be the subject of a one-day symposium to be held by the London Branch of the Institute of Metal Finishing, 32 Great Ormond Street, London, W.C.1, on November 19, at the Charing Cross Hotel, London.

The Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1, report that their Export Committee is engaged in preparing a booklet to be entitled: How to Export Tools and Gauges. The object is to assist member firms who wish to enter the export field for the first time.

Protolite, Ltd., will move their main office, on October 27, to the premises of the parent company, Murex, Ltd., and the address will be Rainham, Essex (telephone number, Rainham, Essex 3322. Telegraphic address, Protolite, Rainham-Dagenham Telex.). A Southern Region area office will be retained at Central House, Upper Woburn Place, London, W.C.1, at which members of the London Area sales staff can be contacted.

The Igranic Electric Co., Ltd., recently held an "open day," and visitors to the Bedford works, including friends and relations of the employees and guests of the management, numbered about 6,000. Extended tours of the various departments were arranged, which afforded an opportunity of observing the high standard of the facilities provided throughout, and the great variety of work undertaken.

Hawnt & Co., Ltd., 59 Moor Street, Birmingham, 4, will stage an exhibition of electronic equipment on October 21 and 22 (10 a.m. to 7 p.m.) at Bennett Hall, Central Y.M.C.A., Snow Hill, Birmingham, 4. A wide range of products will be on view, and the exhibitors will include Advance Components, Ltd., Associated Lead, Ltd., Avo, Ltd., Belling & Lee, Ltd., Boulton Paul Aircraft, Ltd. (Electronics), Cossor Instruments, Ltd., Dawe Instruments, Ltd., Goodmans Industries, Ltd., Isotope Developments, Ltd., London Instrument Co., Ltd., Mullard, Ltd., Nagard, Ltd., and Rank Cintel, Ltd.

Alfred Herbert, Ltd., P.O. Box No. 30, Edgwick Works, Coventry, have been appointed sole distributors in the British Isles for the range of measuring and inspection equipment made by Censor of Liechtenstein. This equipment comprises high-speed, high-precision, roller and needle sorting and grading machines for the bearing industry, ranging from simple accept/reject machines to those capable of sorting into seven different grades and rejecting over- and under-size components, also multi-dimension inspection machines for very small parts.

Sykes Machine Tool Co., Ltd., Staines, Middlesex, have been appointed by Schiess, A.-G., Dusseldorf-Oberkassel, sole British agents for Schiess type RF precision gear hobbing machines, RFw horizontal pinion hobbing machines, and RS20 vertical gear shaping machines. There are four sizes of RF precision gear hobbers for maximum gear diameters of 138, 177, 217 and 276 in.; and three sizes of RFw horizontal pinion hobbers for maximum diameters of 35½, 49 and 71 in. The RS20 vertical gear shaper has a capacity for gears up to 79 in. diameter, 10⅝ in. face width, and 15 module.

J. A. Crabtree & Co., Ltd., Lincoln Works, Walsall, Staffs., are to hold an exhibition of their products at The Royal Turks Head, Grey Street, Newcastle-on-Tyne, 1, from November 3 to 7. The display will be concerned principally with the types B-15 and B-26 air-break contactor gear, and the type D-6 manual starter, also auxiliary equipment and limit switches, and these items will be shown both individually and incorporated in various control panels to demonstrate their versatility and wide ranges of application. Miniature circuit breakers and industrial wiring accessories will also be on view. Applications for tickets should be sent to the company at the above address.

Vickers-McKay, Ltd., is the title of a new company which has been formed by The McKay Machine Co., Youngstown, Ohio, U.S.A., Vickers-Armstrongs (Engineers), Ltd., and Rockwell Machine Tool Co., Ltd., to build in the United Kingdom, and market throughout the world, a wide range of McKay machinery. The directors of the company are: Mr. R. Wonfor (chairman), Mr. W. M. Briggs, Mr. C. E. Rockwell, and Mr. A. J. Wardle, Jr., and the registered office will be at Vickers House, Broadway, Westminster, London, S.W.1. This machinery will be built at the works of Vickers-Armstrongs (Engineers), Ltd., and sold by Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2.

Tungsten Manufacturing Co. (1958), Ltd., is the title of a new company which has been formed to acquire the assets and continue the activities of the Tungsten Manufacturing Co., Ltd., which is now in liquidation. The address of the new company is Tremlett Grove Works, Tremlett Grove, London, N.19. It will be completely independent but will function under the same works management. The Tungsten Manufacturing Co., Ltd. was formed in 1919 and became one of the leading makers of tungsten and allied products. Their activities, which will be continued by the new company, include the manufacture of tungsten faced contacts, and tungsten discs, rod, wire, powder, sheet and foil; molybdenum rod, wire, powder, sheet and foil, and moly-tungsten alloy wire; and tantalum metal, which now finds numerous applications in industry.

Helifit Engineering Co., 19 Frankley Avenue, Quinton, Birmingham, 32, has been formed to provide a fitting service in the Midlands for users of Heli-coil thread repair inserts. This service is intended for those whose requirements are not sufficient to justify the purchase of a complete Heli-coil thread repair kit, and damaged parts can be sent for repair direct to the company's factory at Hainge Road, Tividale, Tipton. Alternatively, the company will arrange for an engineer to visit the customer's premises to effect a repair on site.

Mortimer/Stanhope Exhibition

An exhibition of machine tools, organized jointly by the Mortimer Engineering Co., 202/206 Acton Lane, London, N.W.10, and Stanhope Machine Tools, Ltd., will be held at the above address from October 20 to 31. The principal exhibit will be a Ravensburg type KH.55 all-hydraulic facing lathe, which was first shown at the 1957 Hanover Exhibition. This machine, which was described in Machinery, 91/1034—1/11/57, incorporates Unicop copying equipment for controlling both the transverse and in-feed motions, so that virtually any profile can be produced at a single operation, limitations in this respect being imposed by the tool rather than the copying equipment. Demonstrations will be given on this machine of copy-turning profiles, which, because of their shape, would normally be considered unsuitable for this type of operation.

Other machines on show will include a Ravensburg KT 45 hydraulic face-copying lathe, Maho universal jig millers and die sinkers, Fromag hydraulic keyseaters, Gambin universal milling machines with bi-rotary sliding heads, a G.S.P. automatic co-ordinate jig boring table, and a Rouchaud automatic cycle production milling machine. There will also be a display of lathes and milling machines by Koping, grinders by Thule and Carstens, radial drilling machines, high-speed shapers, and the Ainjest screwcutting attachment which can be fitted to standard lathes to provide for high-speed threading operations.

Copy-turning Demonstrations

Vaughan Associates, Ltd., have arranged for demonstrations of +GF+ copy-turning lathes to be given at Trent Works, Wilford Crescent, Nottingham, from October 20 to 25. Machines on view will include a KDM-11/70 set up for turning crown wheel blanks with ceramic tools; a transfer group comprising two KDM-7/50 lathes arranged for operations on a textile machine component; a KDM-18/150 equipped for turning a stub axle, with automatic speed changing; and a KDM-11/40, with bar feed, set up for producing a pump rotor shaft.

Employment in the Metal Industries

(*Continued from page* 863)

employed. For the three metal industries groups, the total number of vacancies unfilled at August 6 was 43·2 per cent of the number registered as unemployed for those groups.

Particularly as regards the metal industries, therefore, it would appear that there is a substantial problem of labour distribution, as well as a temporary labour surplus. It is to be hoped that more vigorous measures will be taken to stimulate industrial activity, especially in the heavier branches, during the coming months, for it is certain that the country cannot afford idle hands or idle plant.

Scrap Metals

†London.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—clean copper wire, untinned and free from lead and solder, £174; clean heavy copper, untinned and free from lead and solder, £163; copper, wire, No. 2, £158; clean light copper, £152; braziery copper, £136; gunmetal, £139; brass, mixed, £97; lead, net, £57; zinc, £30; cast aluminium, £92; old rolled aluminium, £111; battery lead, £30; unsweated brass radiators, £87; hollow pewter, £498; black pewter, £368.

Midlands.—Although most grades of scrap can only be delivered to consumers against meagre allocations, it is noticeable, at present, that there is a growing demand for light and medium cast iron and light steel cuttings. This phase may only be temporary, but merchants are welcoming the first sign of better trading.

Heavy steel scrap is not yet moving, and merchants are carrying very large stocks. Chipped turnings are produced in substantial tonnages in the Midlands and quantities are being stored against future demand. In consequence, prices offered for turnings have been reduced considerably over the past few weeks. There is no sale for bushy turnings apart from the supply of odd wagon loads to the blast furnaces.

Cast iron borings can be placed, although demand varies from week to week. Machinery quality cast iron scrap is being delivered steadily to local foundries, where stocks are now kept at a low level.

Light iron and destructor scrap are not wanted.

Current maximum control prices, delivered consumers' works, are now: *Heavy steel No. 1, 217s. 6d.; *heavy steel No. 2, 196s.; *heavy steel No. 4, 207s. 6d.; *heavy steel No. 5, 195s. 6d.; light iron No. 8, 149s.; short turnings No. 9 (free from alloy), 167s. 3d.; light steel No. 11, 164s. 3d.; bushy turnings, 117s.; short alloy turnings, 160s. 9d.; short steel No. 2, 233s. 3d.; machinery cast, 233s.

Prices may be increased up to 2s. 6d. per ton according to quantities tendered over a given period.

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* For use by Round Oak Steelworks, Brierley Hill, increase by 1s. 6d. per ton.

† George Cohen, Sons & Co., Ltd., 600 Commercial Road, E.14.

‡ Subject to market fluctuations.

Machine Tool Share Market

Stock markets were strong and active during the period under review, and there were many good features. Outstanding was the upward movement in commercial and industrial shares. High grade issues took the lead, and many substantial gains were shown on balance.

Sentiment was helped by the satisfactory United Kingdom gold and dollar reserve figures for September, and was further stimulated by good company results, and a number of other favourable factors.

In the gilt-edged section there was sustained investment support, and British Funds, together with Home corporation and Dominion loans, finished with a general rise in values.

Among machine tool issues, Edgar Allen advanced 1s. 3d. to 35s. 6d.; Arnott & Harrison, 6d. to 15s. 6d.; Churchill Machine Tool, 1½d. to 17s. 4½d.; Coventry Gauge & Tool, 1½d. to 16s. 3d.; Craven Bros. (Manchester), 9d. to 8s. 4½d.; Kayser Ellison, 1s. to 45s. 1d.; F. Pratt, 1s. 3d. to 22s. 6d.; John Shaw & Sons (Wolverhampton), 7½d. to 13s. 9d.; Sheffield Twist Drill, 3d. to 12s. 3d.; W. E. Sykes, 2s. to 22s.; and Thos. W. Ward, 1s. to 84s. 6d. On the other hand, Geo. Cohen lost 3d. at 10s. 6d.; John Holroyd "A" 3d. at 12s. 9d.; John Holroyd "B," 3d. at 12s. 3d.; and Chas. Churchill, 1½d. at 5s.

MODERN ENGINEERING MACHINE TOOLS, LTD.—Final dividend 4 per cent, making 16 per cent for the year to March 31 last; also a special interim dividend of 8 per cent in respect of the current year.

Books Received

THE RUGBY ENGINEERING SOCIETY PROCEEDINGS. The Rugby Engineering Society, c/o The British Thomson-Houston Co., Ltd., Rugby. 114 pp. [Price 10s. 6d.]

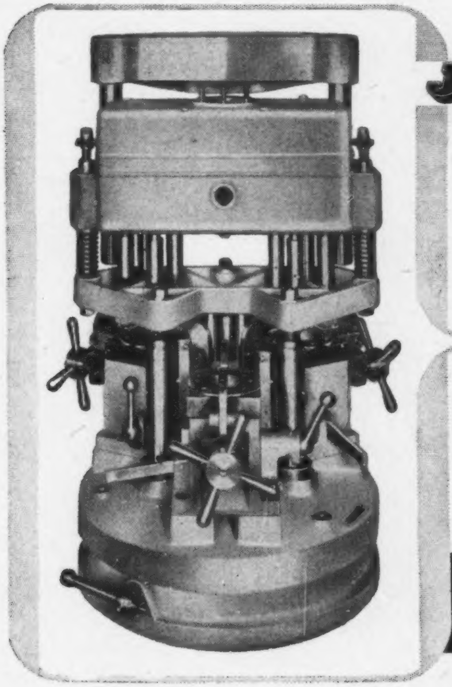
Among the titles of the papers read during the 1957-58 session and reprinted in the proceedings are the following: the philosophy of an engineer; solar energy; development and control of process lines in the metal industries; and the Jodrell Bank radio telescope.

THE FIRST ADVANCED PURCHASING COURSE. The Purchasing Officers Association, Wardrobe Court, 146A Queen, Victoria Street, E.C.4. 122 pp. [Price 10s. 6d. post free.]

This booklet includes the full text of the lectures given by Prof. Howard T. Lewis, at the advanced purchasing course held at Christ Church, Oxford, in April, 1958. The lectures are concerned with the increasing importance of purchasing as a management function, and with the latest American techniques applied to forward buying, value analysis, vendor relations, and purchasing performance evalutaion. Short papers on these subjects, by British authorities, are also presented.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	35/6
" "	5% Prf.	£1	15/3*
Arnott & Harrison, Ltd.	Ord.	4/-	15/6
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	21/3
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	31/9
" " "	5% Cum. "A" Prf.	£1	15/6xd
" " "	6% Cum. "B" Prf.	£1	18/-xd
" " "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	40/-
" " "	6½% Cum. Prf.	£1	22/-
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	13/3
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	15/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	8/-
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/-
" " "	6% Cum. Prf.	£1	26/4½
Churchill Machine Tool Co., Ltd.	Ord.	5/-	17/4½
" " "	6% Cum. Prf.	£1	18/3
Clarkson (Engrs.), Ltd.	Ord.	5/-	15/-xd
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/6
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	16/3
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/4½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3xd
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	50/7½
Harper (John) & Co., Ltd.	Ord.	5/-	15/7½
" "	4½% Red. Cum. Prf.	£1	12/10½
Herbert (Alfred), Ltd.	Ord.	£1	35/7½
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	12/9
" "	"B" Ord.	5/-	12/3
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	23/-
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	45/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	8/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	9/-
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	21/-
" " "	5½% Cum. Prf.	£1	25/9
Pratt (F.) & Co., Ltd.	Ord.	5/-	22/6
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/6
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	43/6
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	13/9
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	12/3
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	7/6
Sykes (W. E.) Ltd.	"B" non-voting Ord.	10/-	22/-
Tap & Die Corporation, Ltd.	Ord.	5/-	8/-
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	18/9
Ward (Thos.) W.), Ltd.	Ord.	£1	84/6
" "	5% Cum. 1st Prf.	£1	16/-
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.



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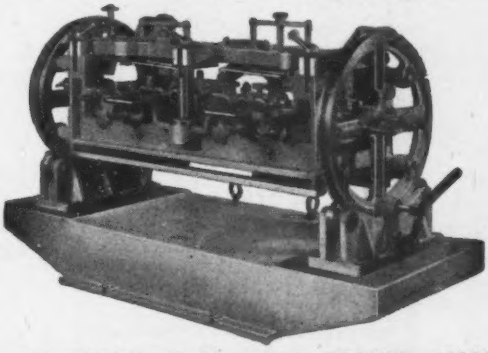

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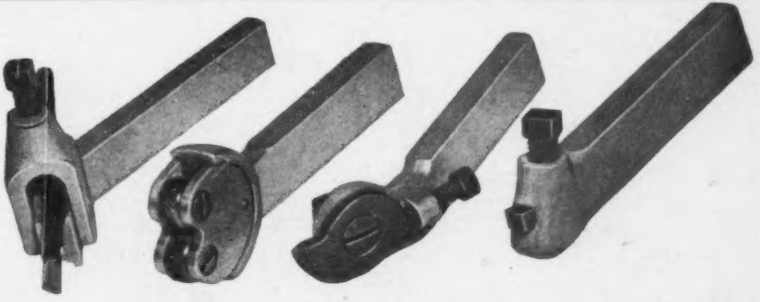

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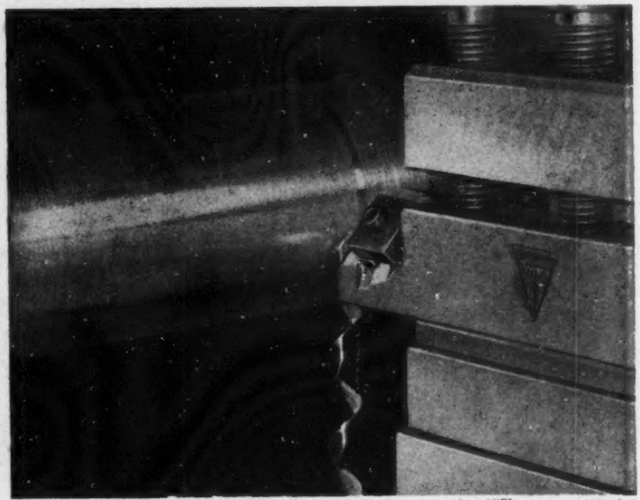

Cross Chord tool cutting S.96, 80-ton steel at 600ft./min. Depth of cut ·0035in., feed 0·06in./rev. By permission of the College of Aeronautics.

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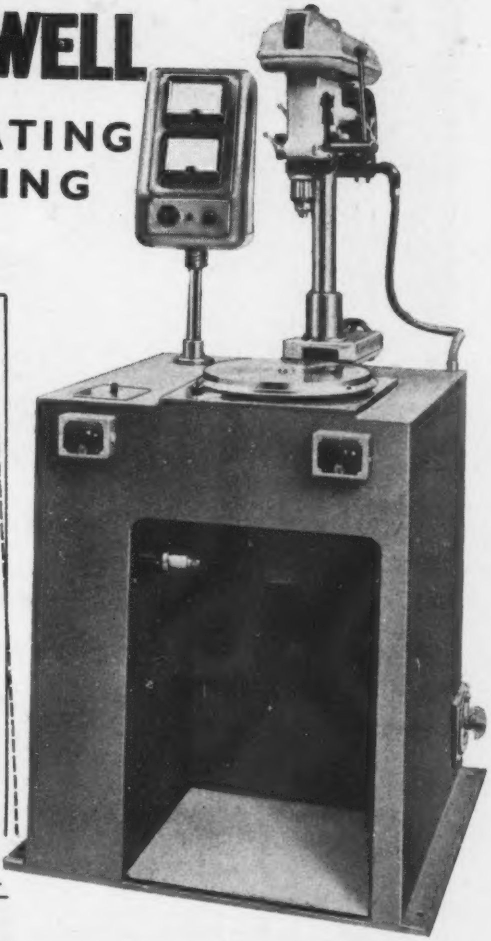

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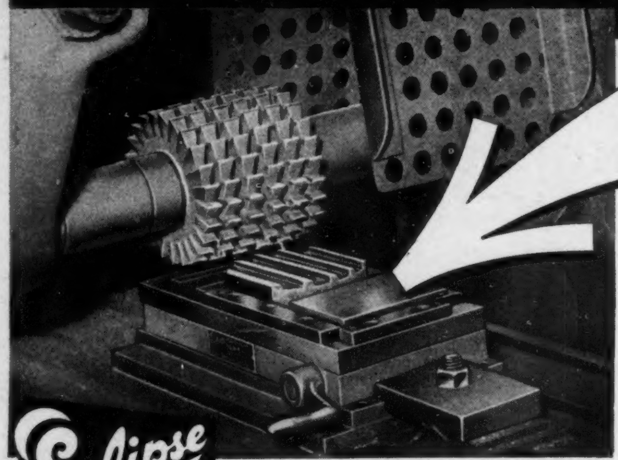

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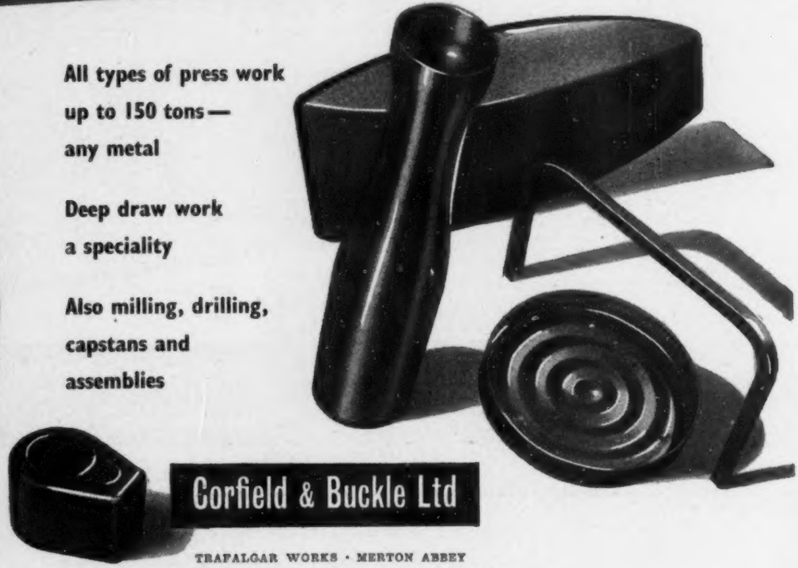

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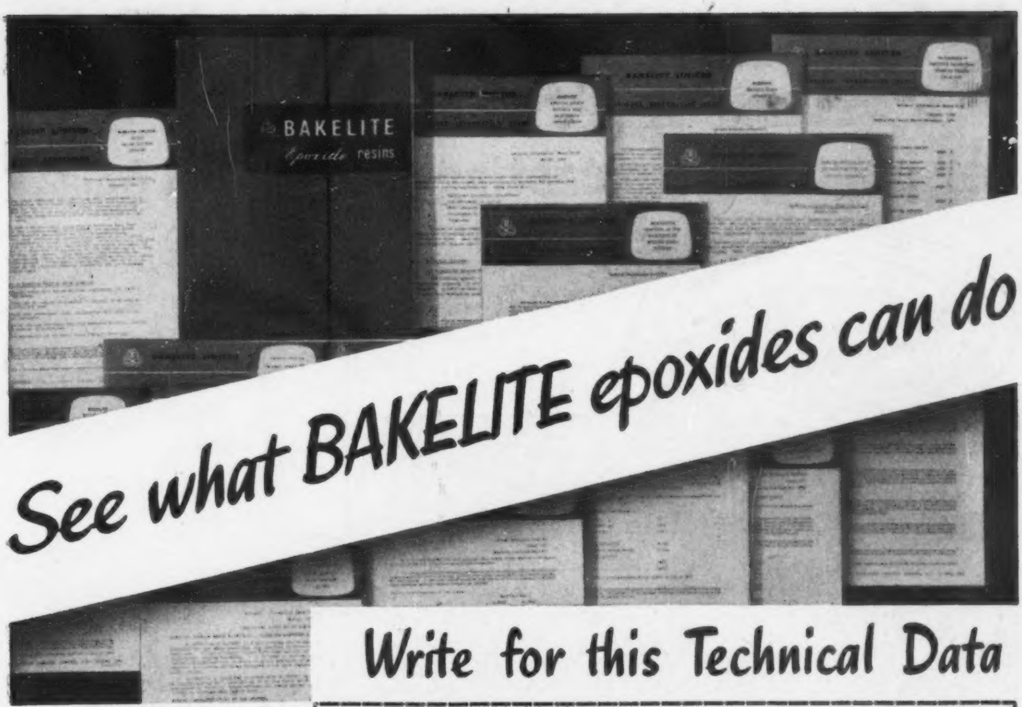

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Here is up-to-date information on the properties and uses of the highly versatile range of Bakelite Epoxide Resins. These remarkable thermosetting materials combine a unique range of properties of special interest to engineers and designers in the electrical, metal fabricating, foundry and plastics industries.

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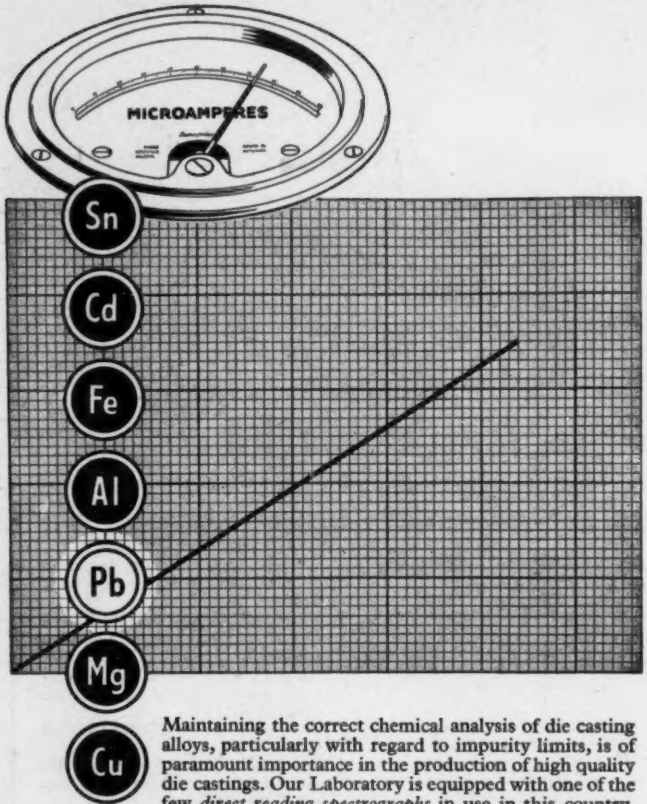

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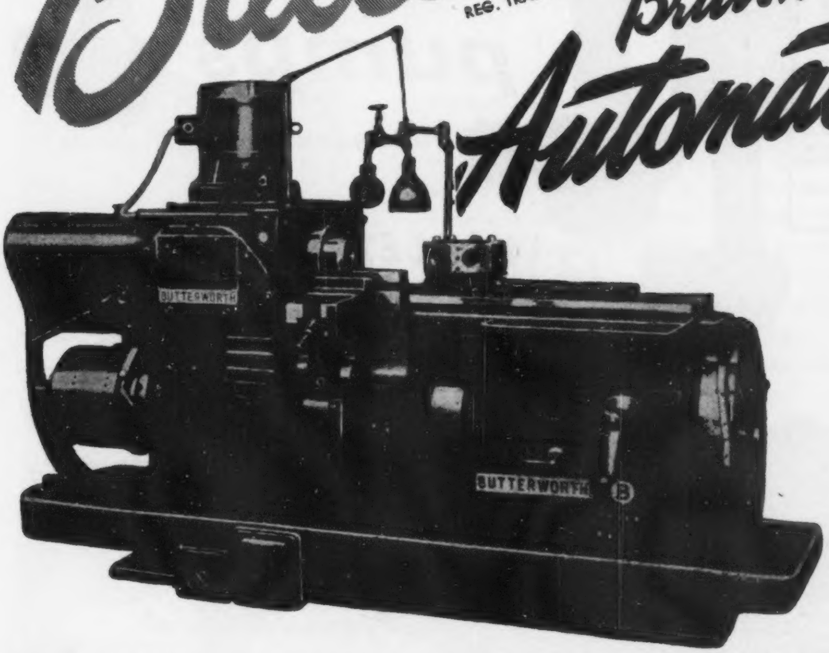

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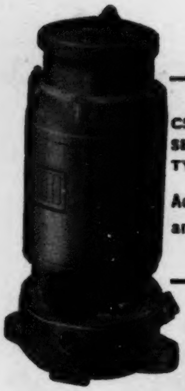

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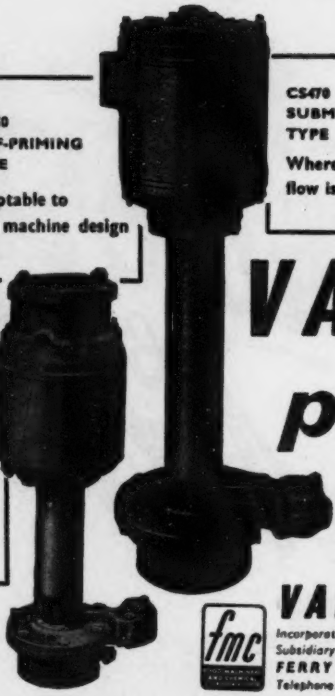

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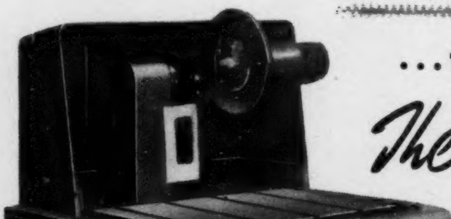

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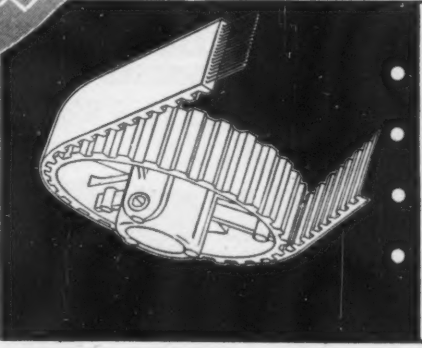

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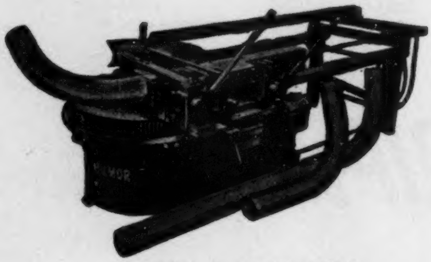
PG7

TUBE BENDING MACHINERY



Illustrated is model MD.46. Produces full bore bends unfilled on short radii up to 6in. dia. non-ferrous tube and 4in. dia. light gauge ferrous tube.

★ Portable Hydraulic Machines to bend Gas and steam tube, light gauge copper and steel, etc., tube.

★ Hand and Power operated general purpose machines to bend up to 5in. diameter light gauge tube.

★ Hand operated and motorised Mandrel machines to produce uniformly accurate full bore bends on extra short radii, cold and without filling.

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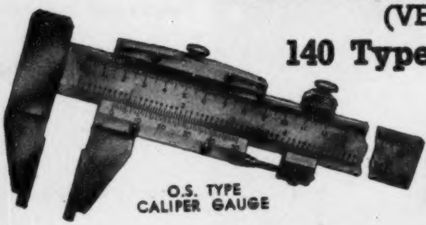
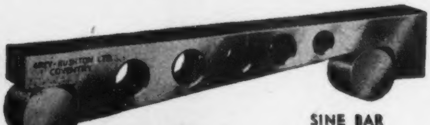
140 Types and Sizes are Available

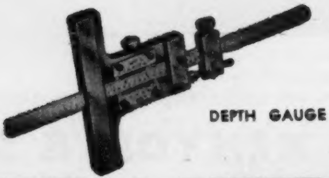


O.S. TYPE CALIPER GAUGE

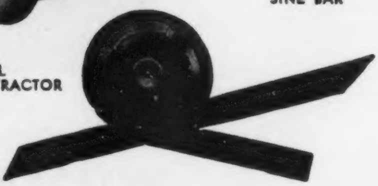


SINE BAR

HD. HEIGHT GAUGE



DEPTH GAUGE



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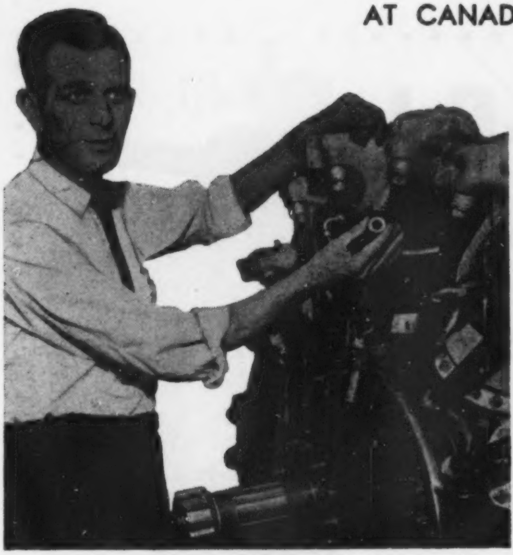
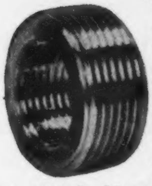
ALMCO

barrel finishing SAVES 97% on deburring and finishing of spark plug bushings





● SAVES 9d. ON EACH BUSHING—Deburring and finishing threaded spark plug bushings like the one shown at the left, formerly cost £37.4.0 per thousand when CP & W used speed lathes, portable power tools and other hand methods.

After installing two ALMCO DB-200 Supersheen units, records showed a cost cut of 97%. This equipment turns out 1,000 bushings in 45 minutes, releases grinders and finishers to other duties. Cost reports showed:

£37.4.0	cost per thousand with power tools.
£ 1.1.0	cost per thousand with 2 ALMCO barrels.
£36.3.0	Savings per thousand pieces.

This year CP & W will process 24,000 spark plug bushings, with a total savings of £867.10.0 on this one part alone.

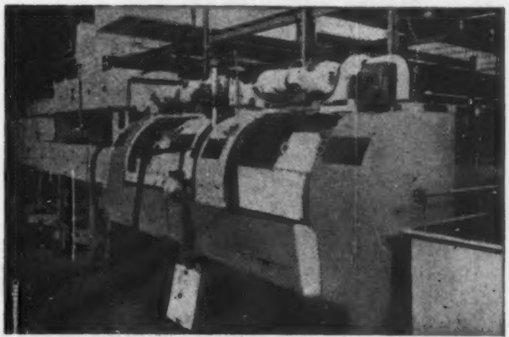
PRACTICALLY ELIMINATES REJECTS—Before installing controlled-type barrel finishing, parts inspectors returned for re-work an average of 125 bushings out of every 1,000 (12½%). With Almco Supersheen equipment and processes, these parts are now finished to a degree of uniformity that is virtually free of rejects.

CUTS DEBURRING AND FINISHING COSTS £867.10.0—Threaded spark plug bushings used in famous Pratt & Whitney aircraft engines will be deburred and finished for £867.10.0 less this year with Almco equipment and processes. Maurice Harrison, Supervisor of Process Planning, shows the small part on which this saving will be made.

DESIGNED FOR MANY METAL FINISHING OPERATIONS—In addition to deburring and finishing, ALMCO equipment and processes are used for descaling, degreasing, grinding, burnishing, work-hardening, rust-inhibiting, polishing, etc.

ALMCO SUPERSHEEN materials, equipment and processes have been developed by engineers and technicians fully trained in all the intricate variables of modern barrel finishing applications.

FREE SAMPLE PROCESSING. ALMCO has ample facilities for running sample parts. Send sample components, with your specifications to our Process Laboratory, your enquiry will be handled promptly. You'll get a complete report on where you can save deburring and finishing costs, improve product quality and appearance, the method and machine best suited for your operation. GET THE FACTS TO-DAY.



Two Model DB-200 Almco machines, using Supersheen bonded abrasive chips and compounds, deburr and polish 1,000 spark plug bushings in 45 minutes at Canadian Pratt and Whitney.

ALMCO Supersheen BURY MEAD WORKS · HITCHIN · HERTS
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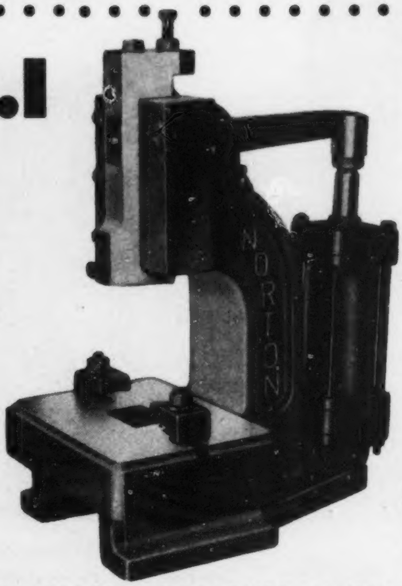

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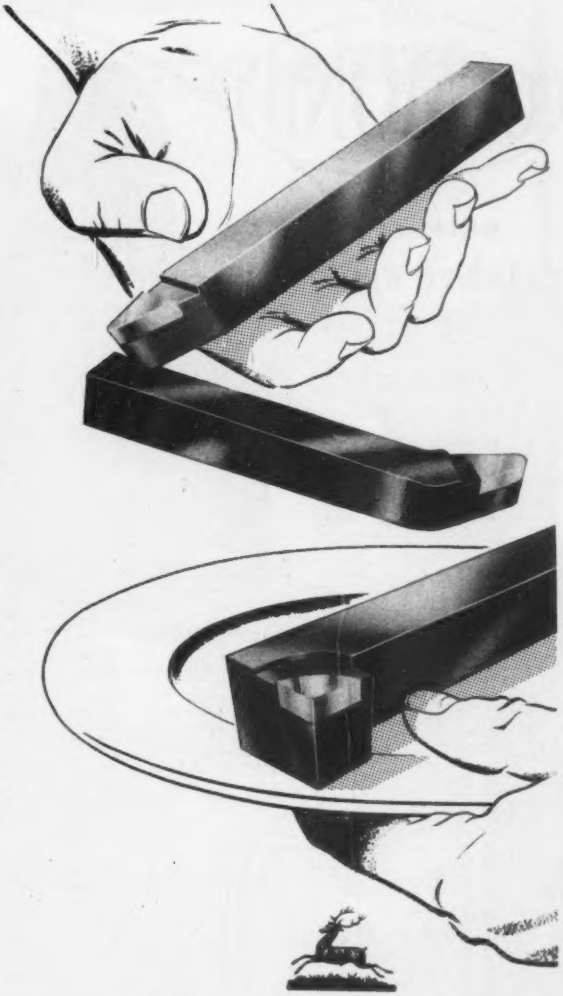

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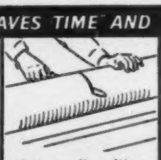

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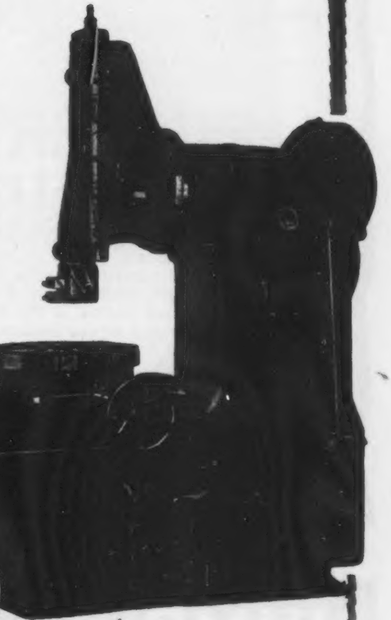
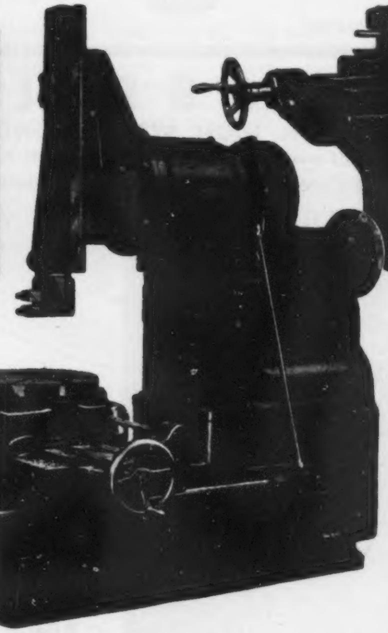


Close-up showing dividing attachment on rotary table



GENERAL PURPOSE MACHINES

The machine above is available in two sizes, with 6½" and 8½" strokes. It possesses many features of the toolroom model described above but is intended primarily to accommodate the many jobs which do not require such extreme accuracy and versatility.

Full details of both types are available on application.

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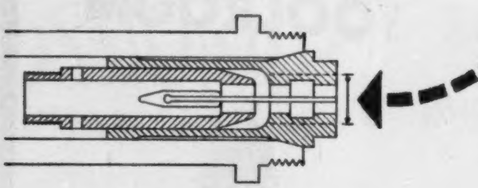

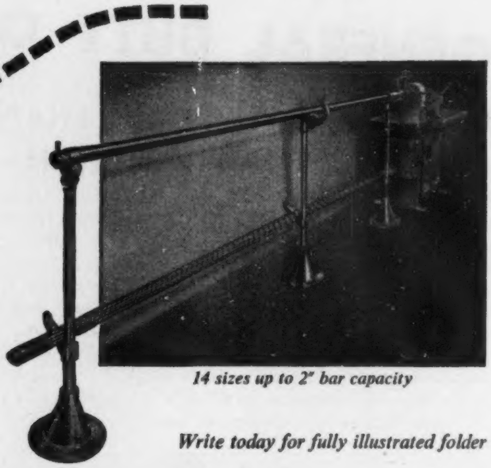

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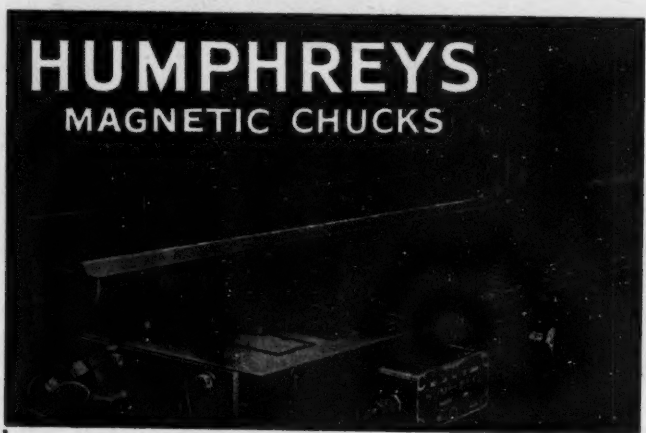

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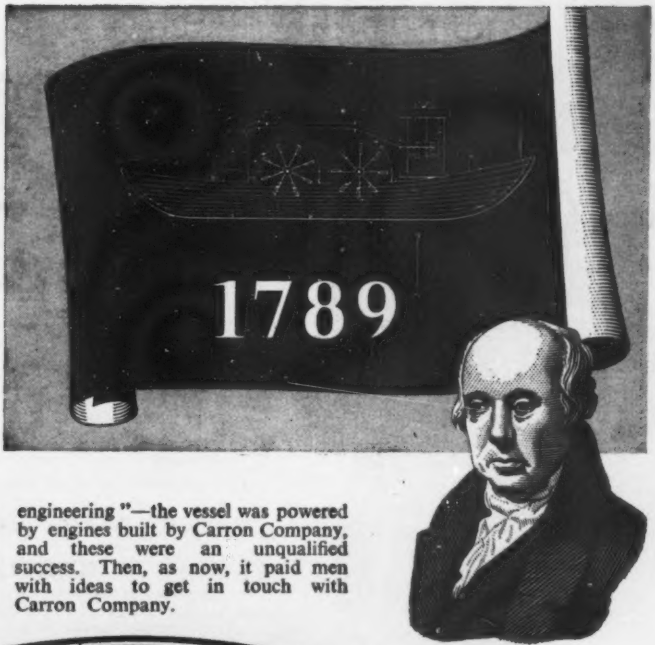

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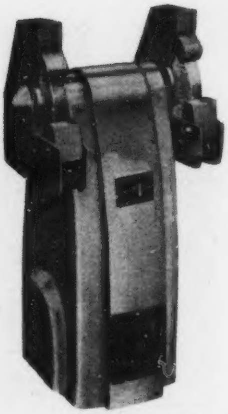

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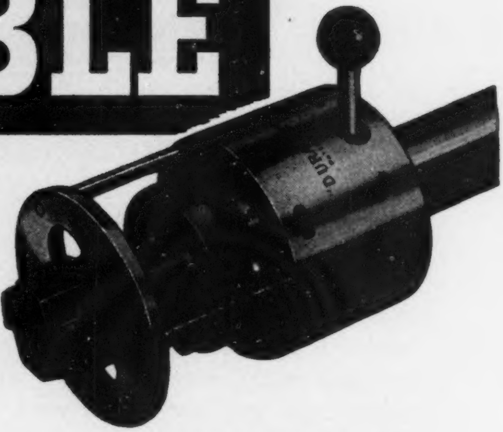

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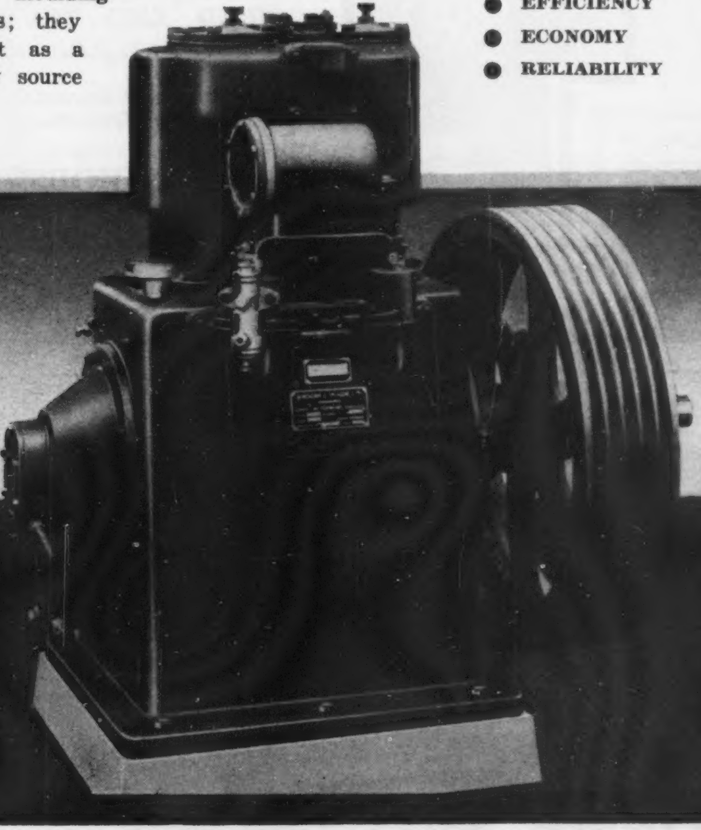

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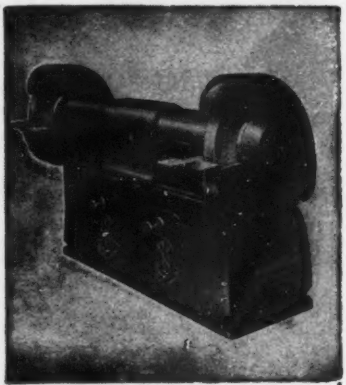

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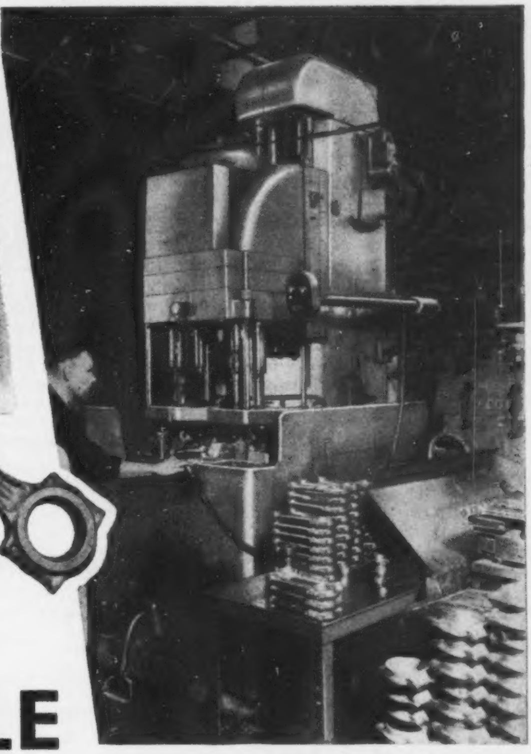

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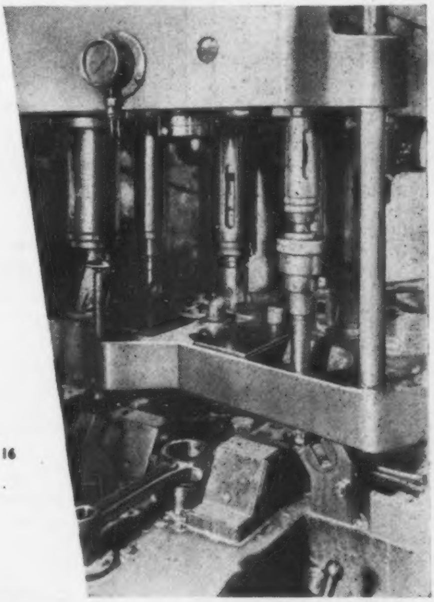

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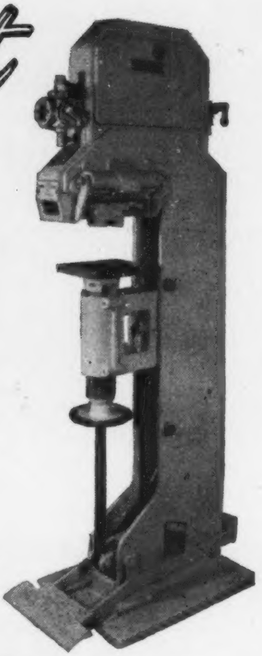

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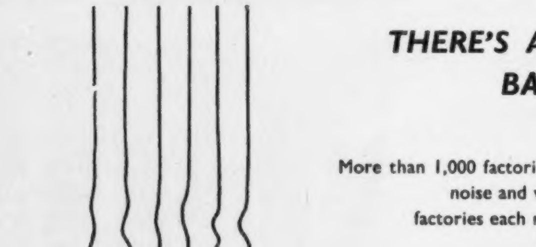

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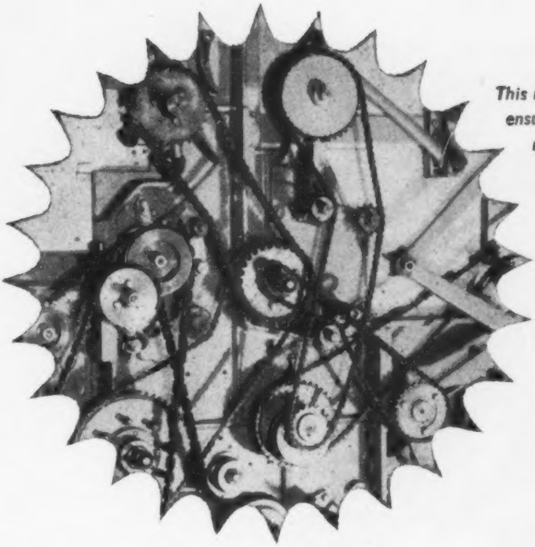

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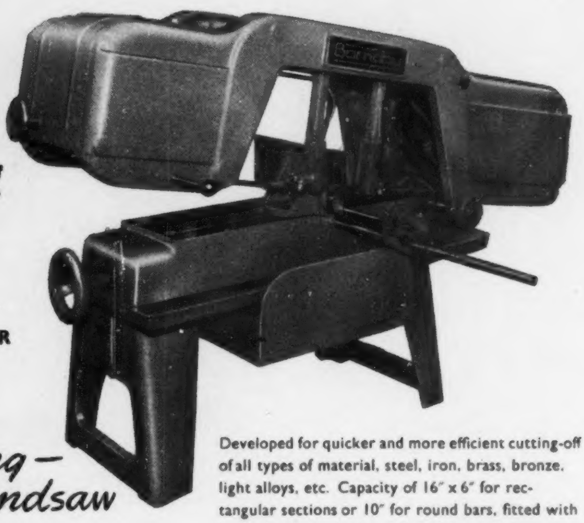

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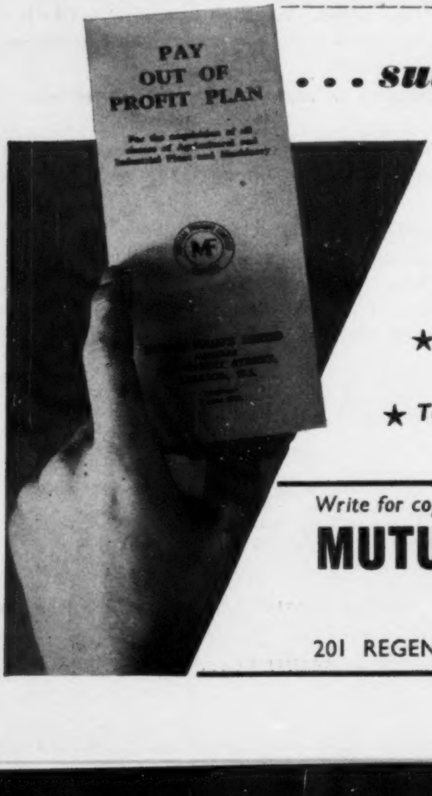

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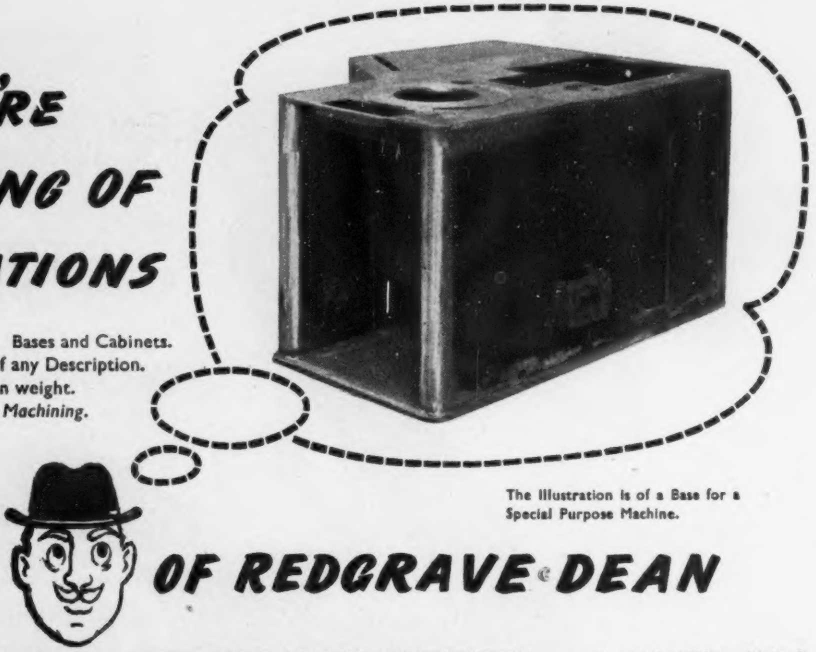

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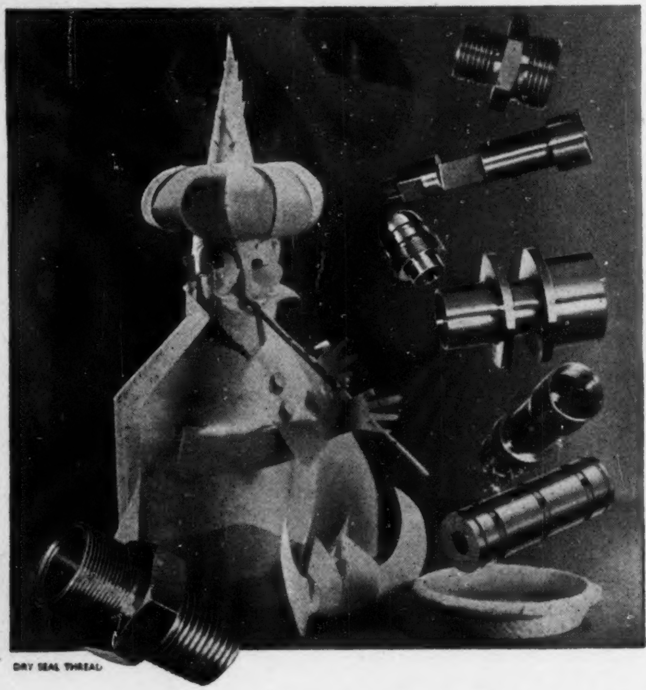

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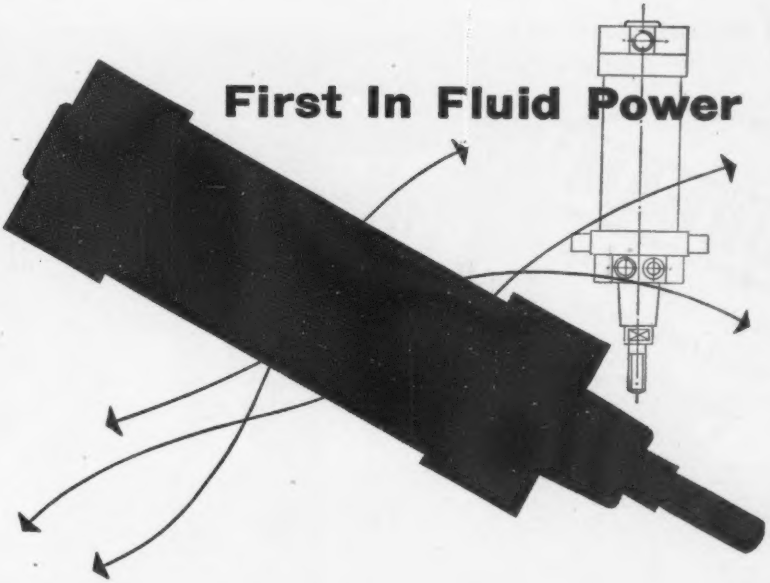

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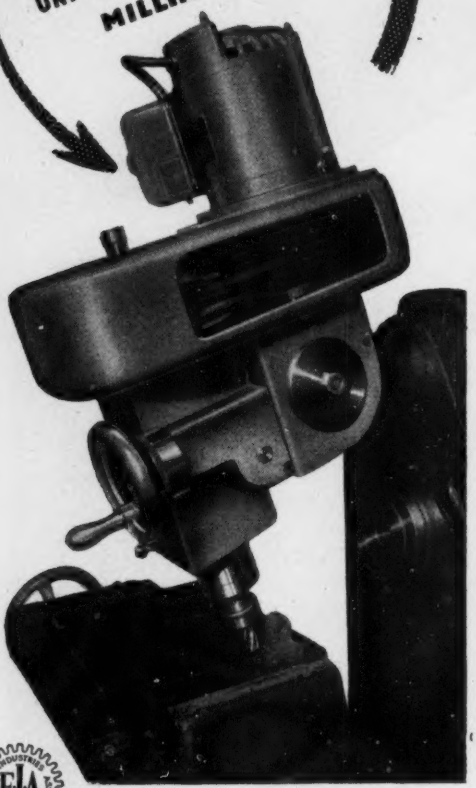

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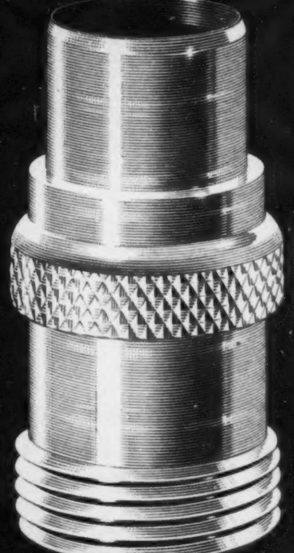

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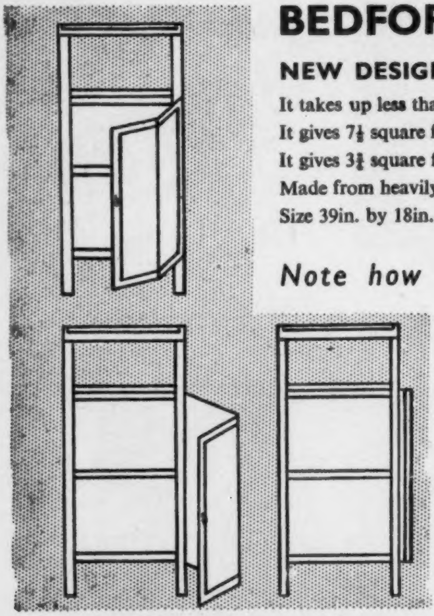

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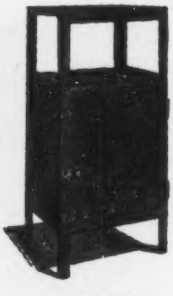

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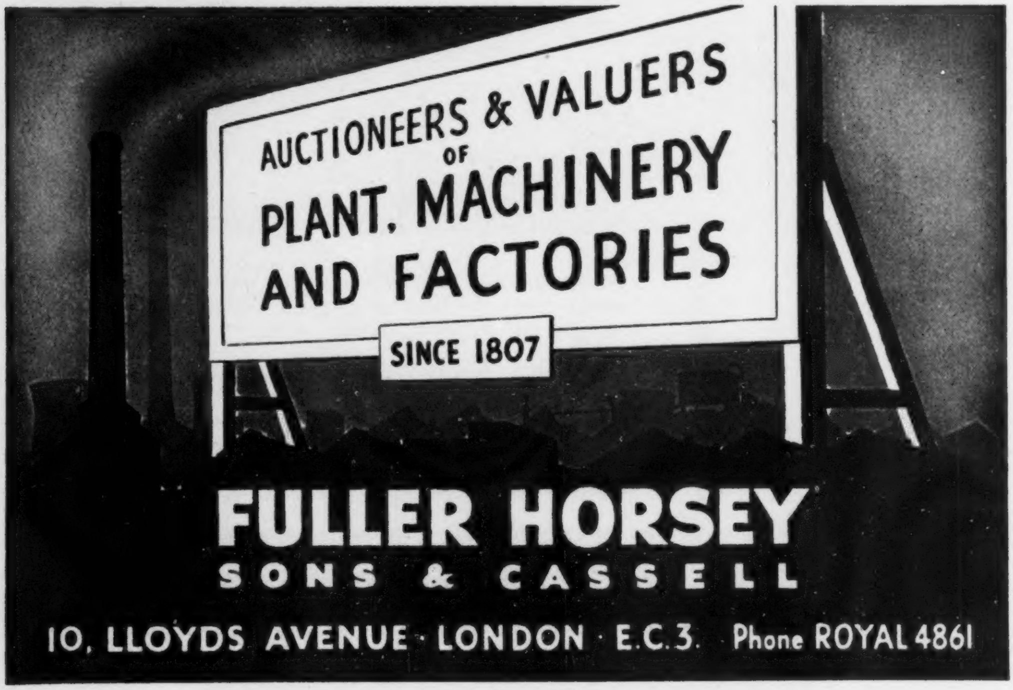

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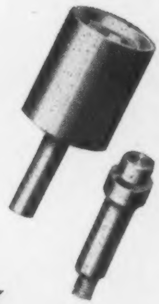

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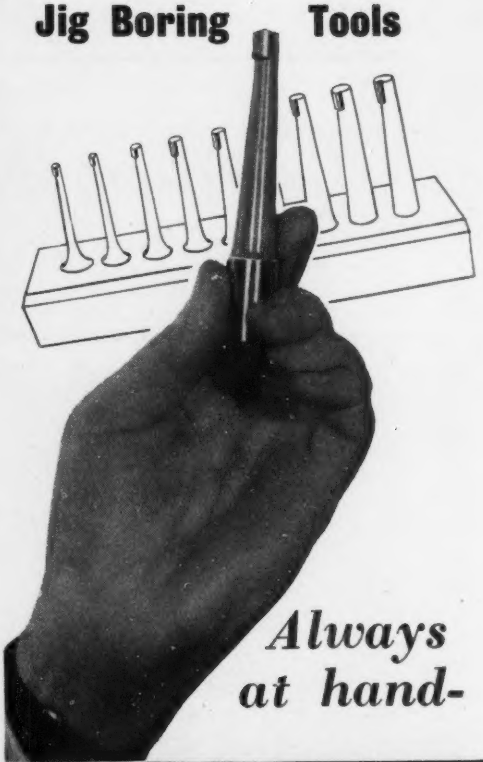

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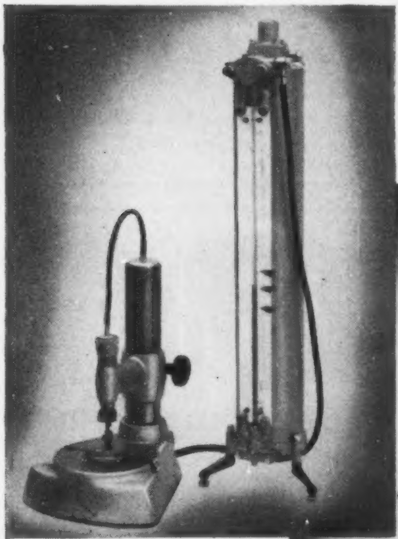

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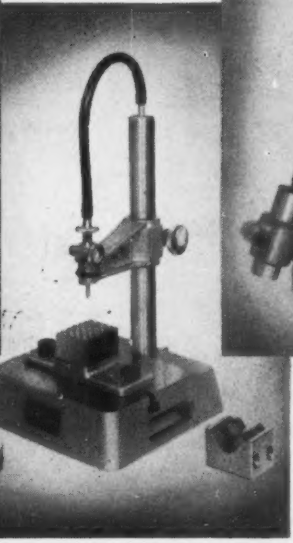

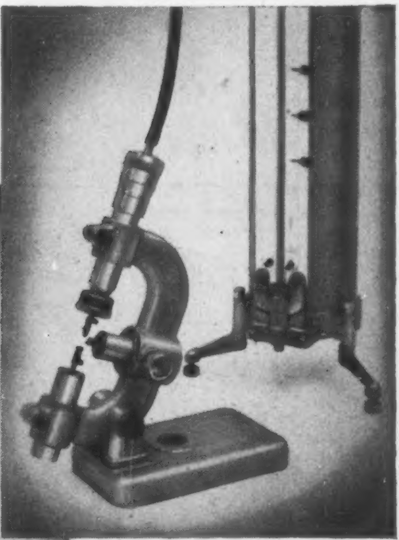

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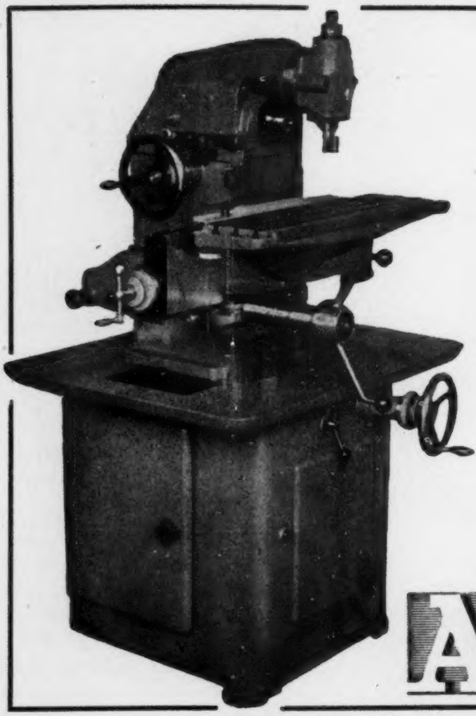

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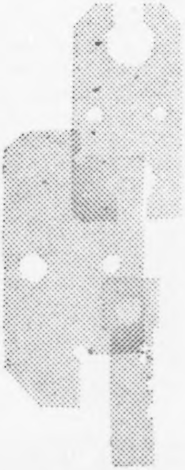

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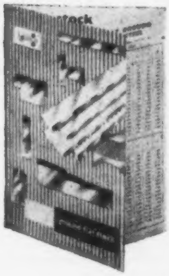

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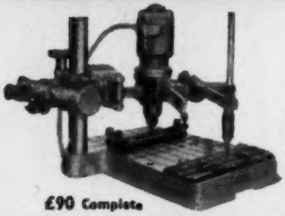

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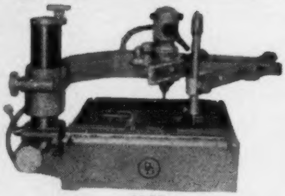

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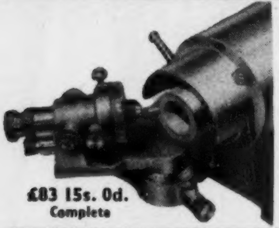

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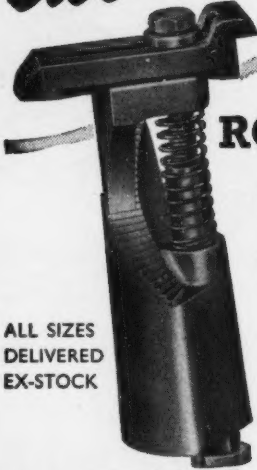

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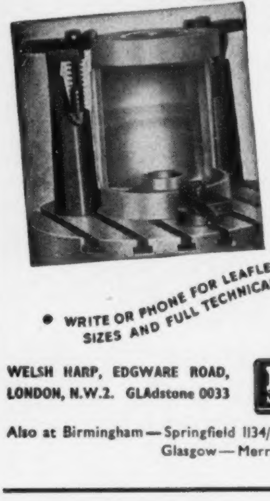

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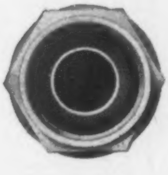

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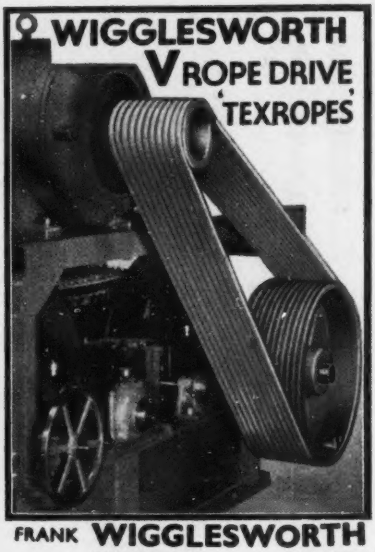

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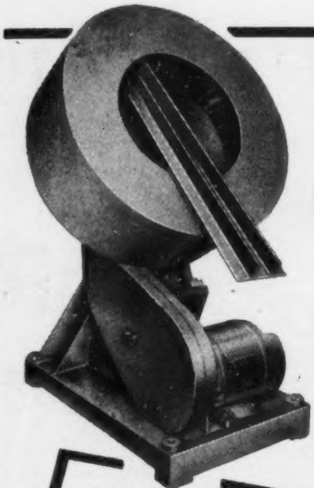

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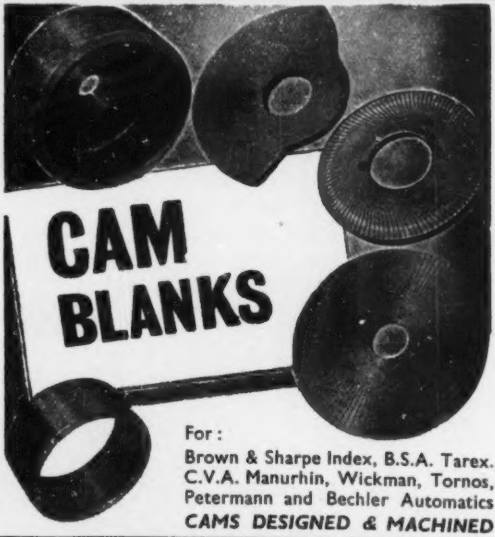

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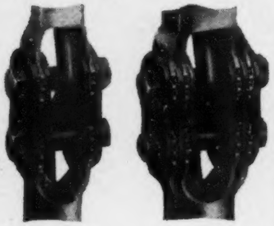

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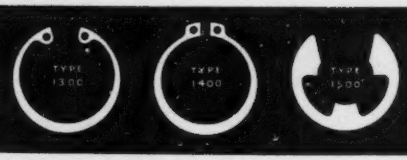

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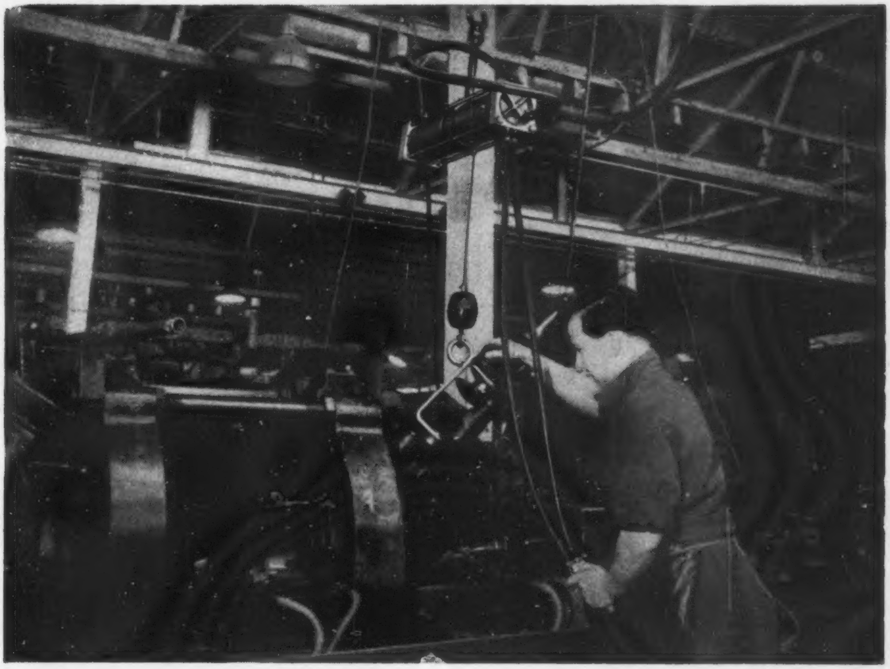

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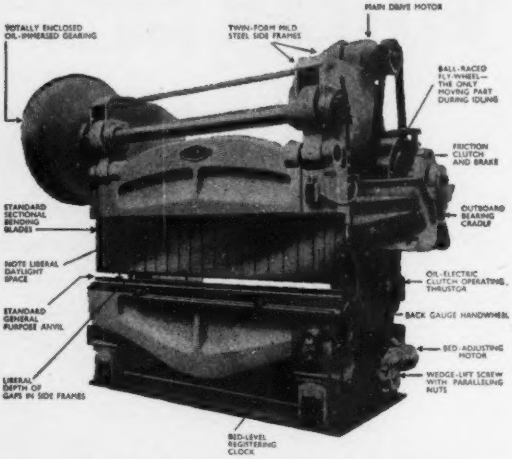
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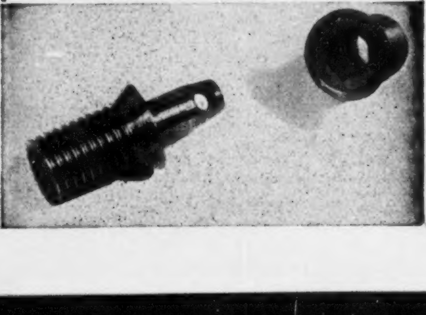

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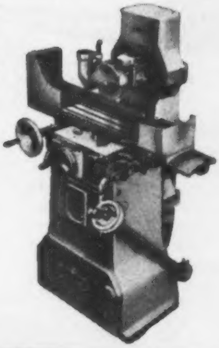

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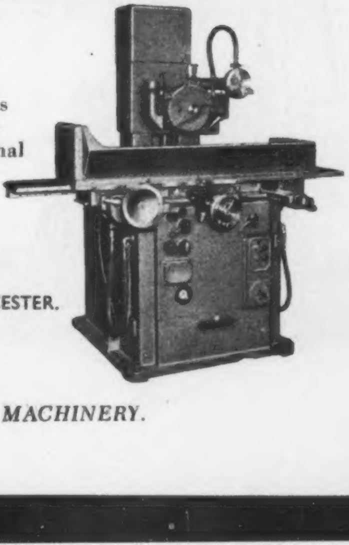

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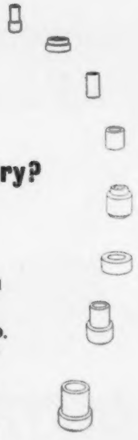

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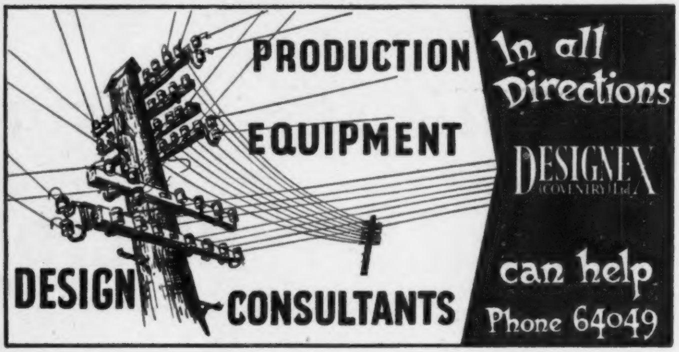

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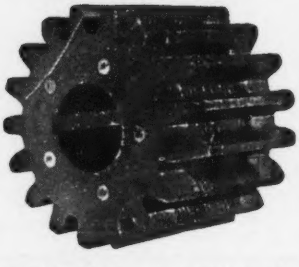

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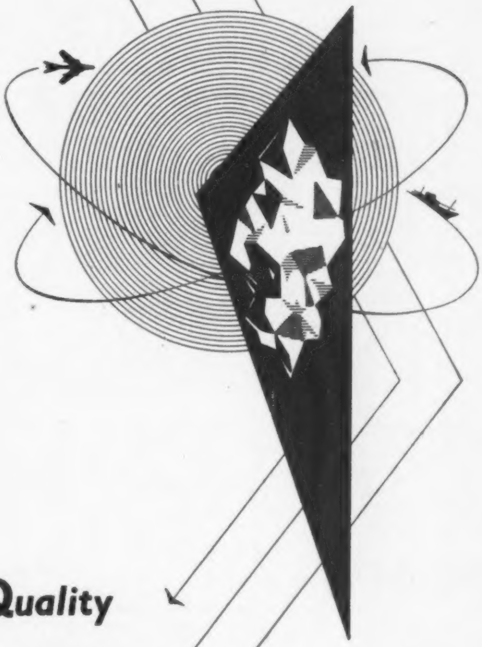

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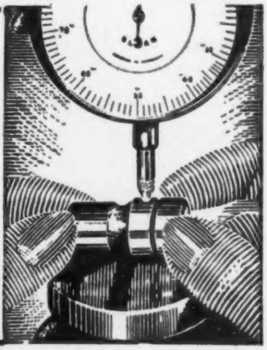

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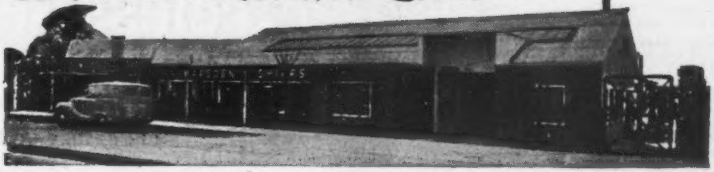

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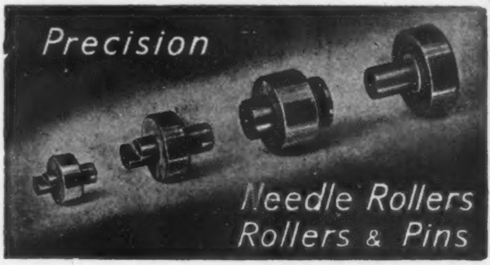

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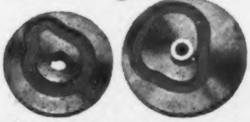

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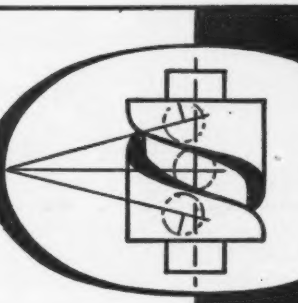

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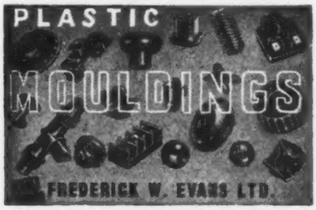

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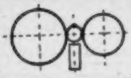

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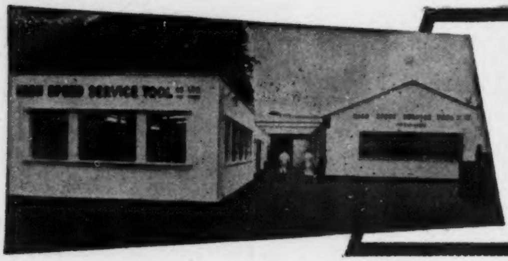

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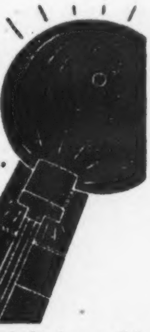

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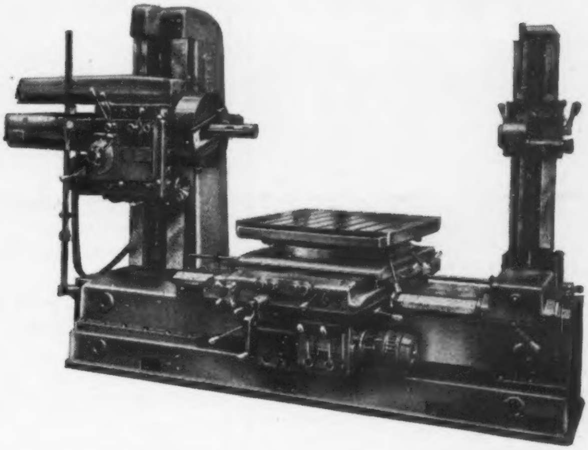

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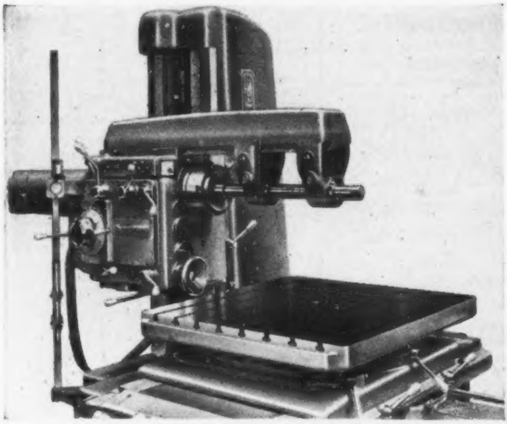

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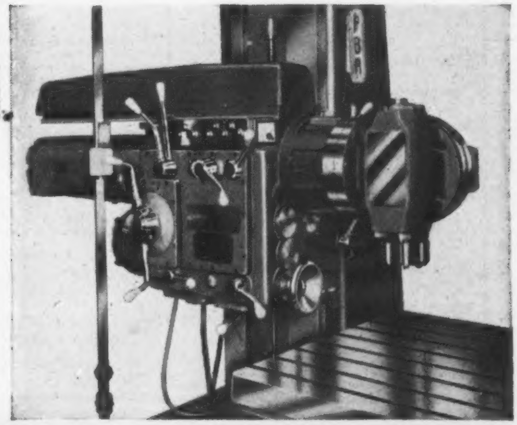

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CHURCHILL REDMAN 24 ND Surfacing and Boring Lathe. 12in. centres × 50in. between. Swing in gap 38in. dia. full range screwcutting, 16 spindle speeds 14-408 r.p.m. Hole through spindle 3½in. dia. 400/3/50. (As new.) S.N. 3703.
BINNS & BERRY Type TB, 12½in. Centre Lathe, 12ft. bed, 16 spindle speeds 12-600 r.p.m. Hole through spindle 4in. dia. 12½in. h.p. motor drive. 400/3/50. New Machine.
WARD 7 Capstan covered bed, bar feed, ball chuck, 8 spindle speeds 37-750 r.p.m., 2¼in. dia. hole through spindle. Chasing attachment. 400/3/50. S.N. 3745.
HERBERT 4 Senior Capstan Preoptive Headstock. 9 spindle speeds 42-1,000 r.p.m. $2\frac{1}{16}$in. dia. hole through spindle. Chasing attachment, chucking machine. 400/3/50. S.N. C105.
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CINCINNATI Mod. 08 Vert., table 24in. by 6in.
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LANG 6½in. S.S. & S.C. Lathe, to admit 2ft. between centres
New COLCHESTER TRIUMPH 7½in. S.S. & S.C. Lathe, cabinet base to admit 4ft. between centres.
LANG 8½in. S.S. & S.C. Lathe, to admit 4ft. 0in. between centres.
COLCHESTER MASCOT 8½in. S.S. & S.C. Lathe, to admit 4ft. 6in. between centres.
VOLMAN 8in. S.S. & S.C Gap Bed Lathe, to admit 4ft. 6in. between centres.
F.L.C.B. 13in. S.S. & S.C. Heavy Duty Lathe, to admit 17ft. between centres, 2 saddles.

CAPSTAN LATHES

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WARD 2A Capstan Lathe, with collet chuck and bar feed, 1½in. capacity.

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B. & S. OOG S.S. Autos, 1942.
LA POINTE 28L Horiz. Broach.
VICTORIA U2 Mill, with dividing hds., 1955.
ACME-GRIDLEY 2½in. S.S. Auto, 1942.
MODERN 6in. × 18in. Surface Gdr., 1953.
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CHURCHILL BD Brake Drum Grinders, max. bore ground 24in., maximum width 10in.

HEY Tooth-rounding Machine, capacity 10in. diameter.

SUNDSTRAND Rigid 20in. Vertical Rotary Milling Machine, 18in. dia. table, 44in. spindle speeds from pick-off gears 7 to 769 r.p.m. Distance centre of spindle to column 18in.

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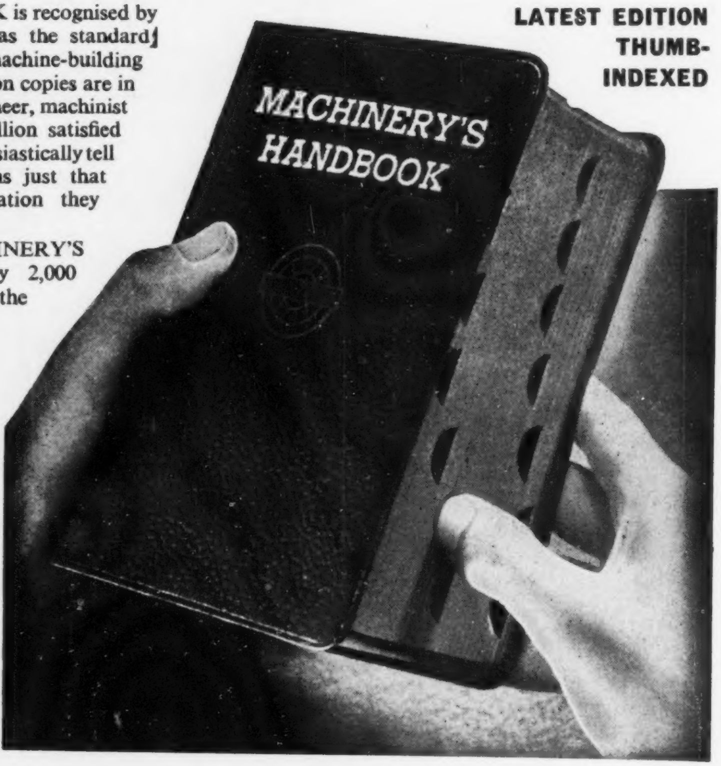

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Salary in accordance with the Burnham Technical Scale for Teachers in Technical Colleges, i.e., £650-£1,025 per annum with allowances for experience and training.

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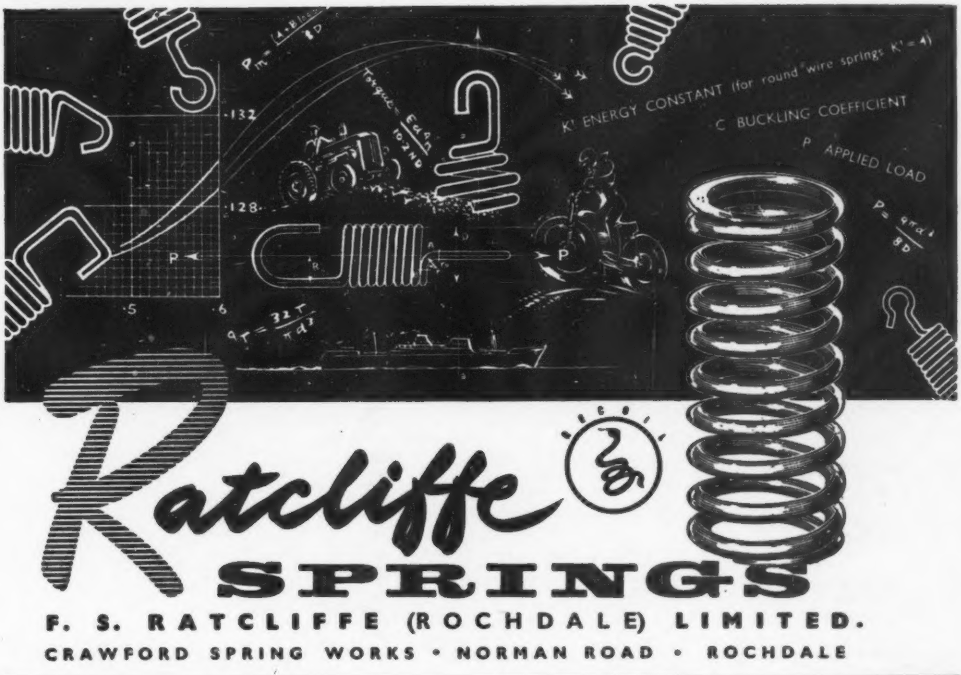
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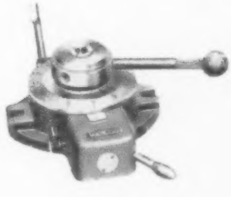

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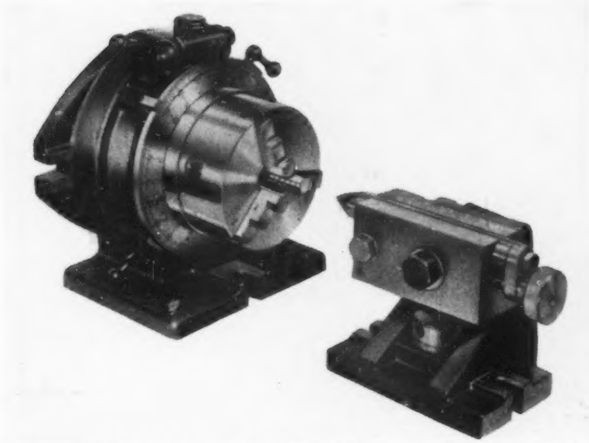

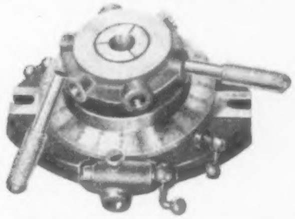

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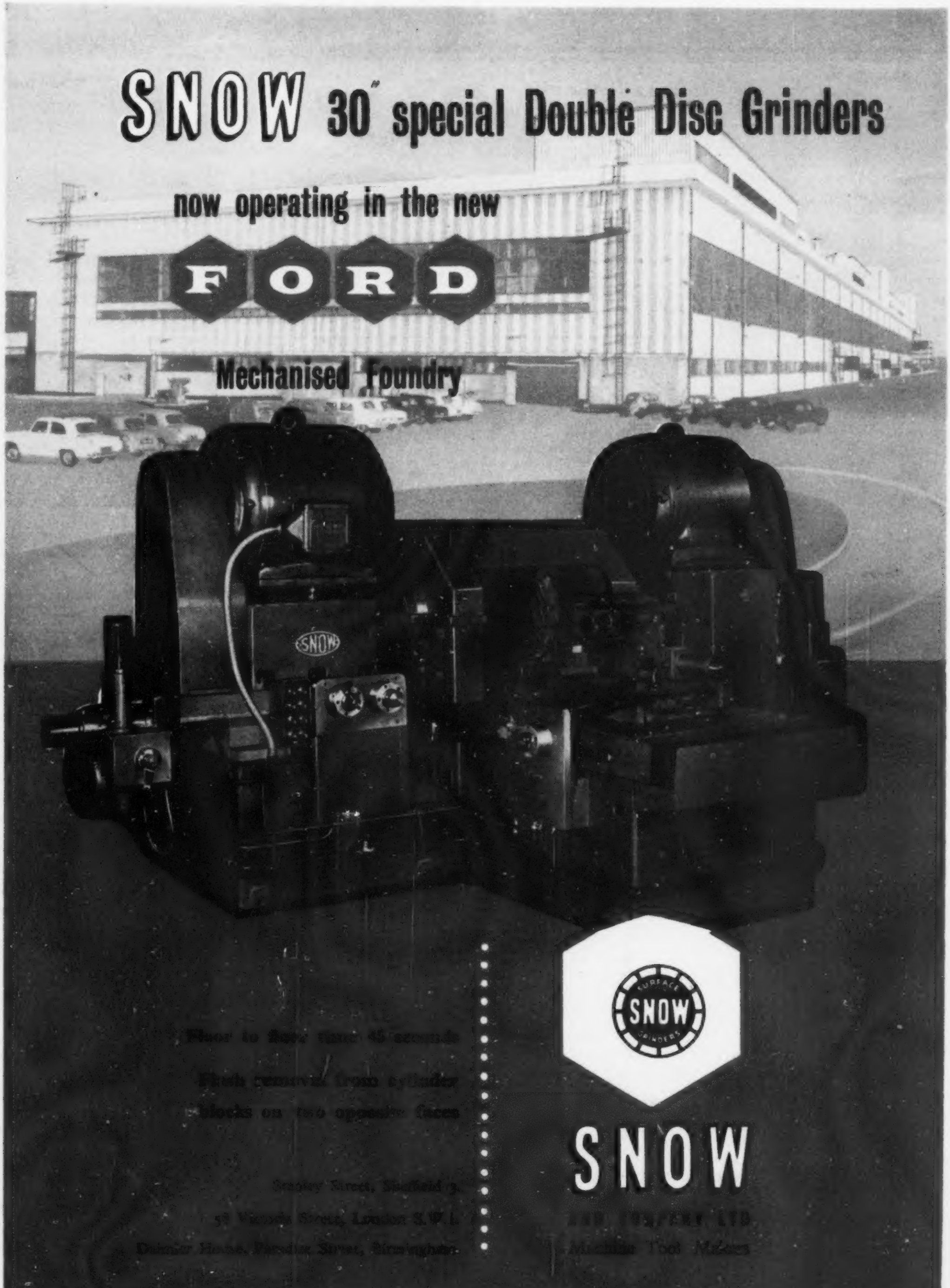

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